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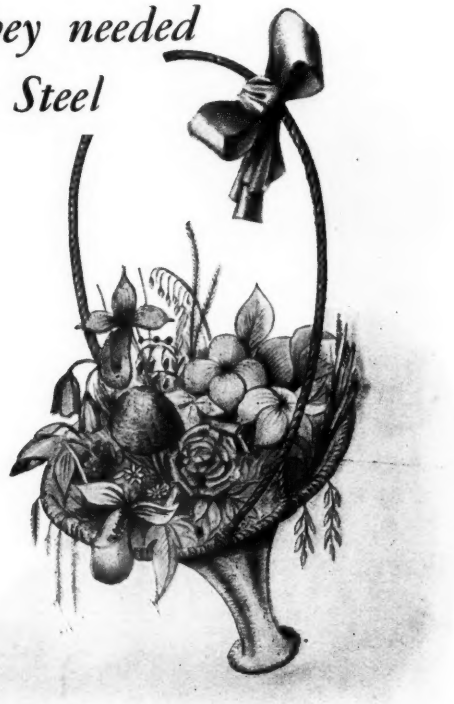

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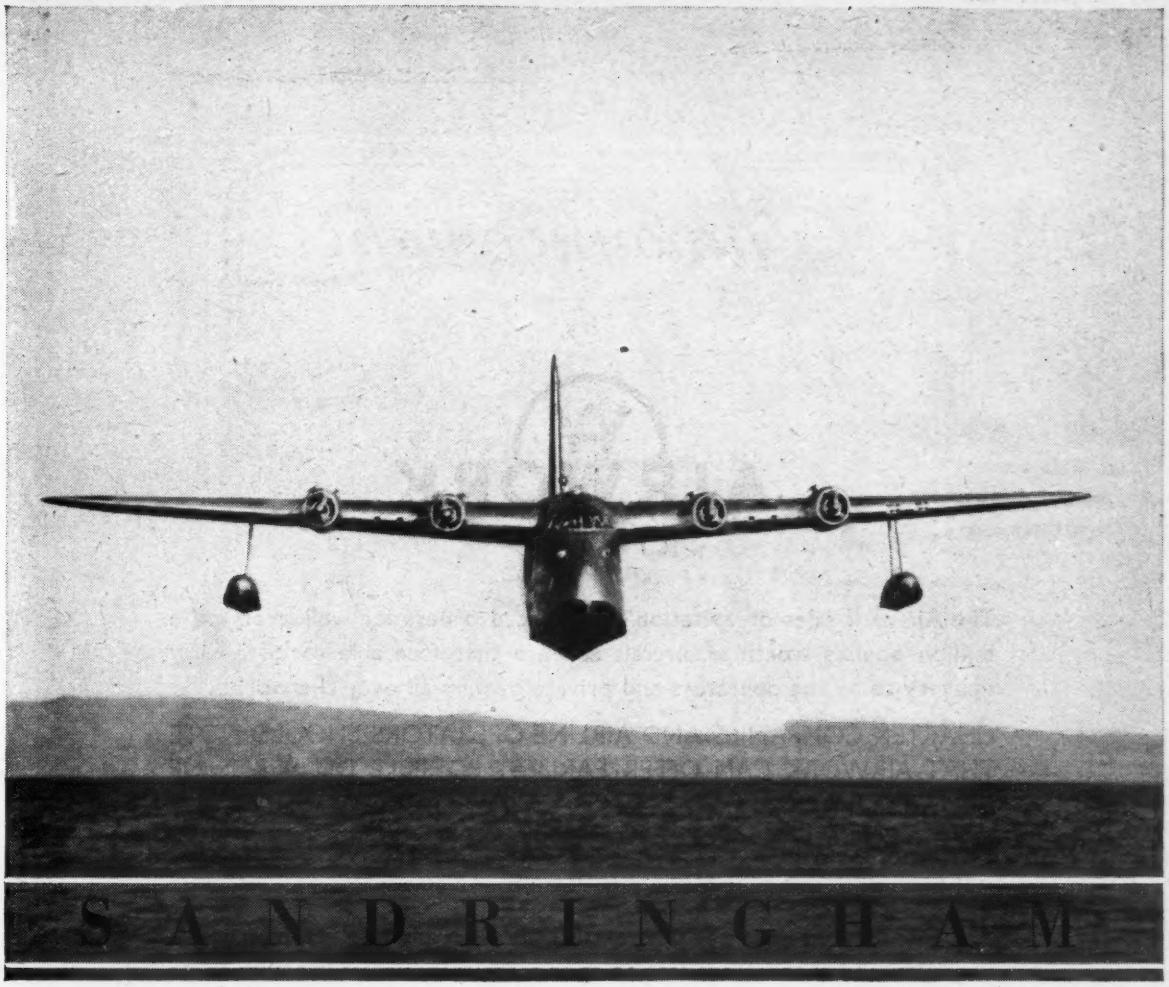

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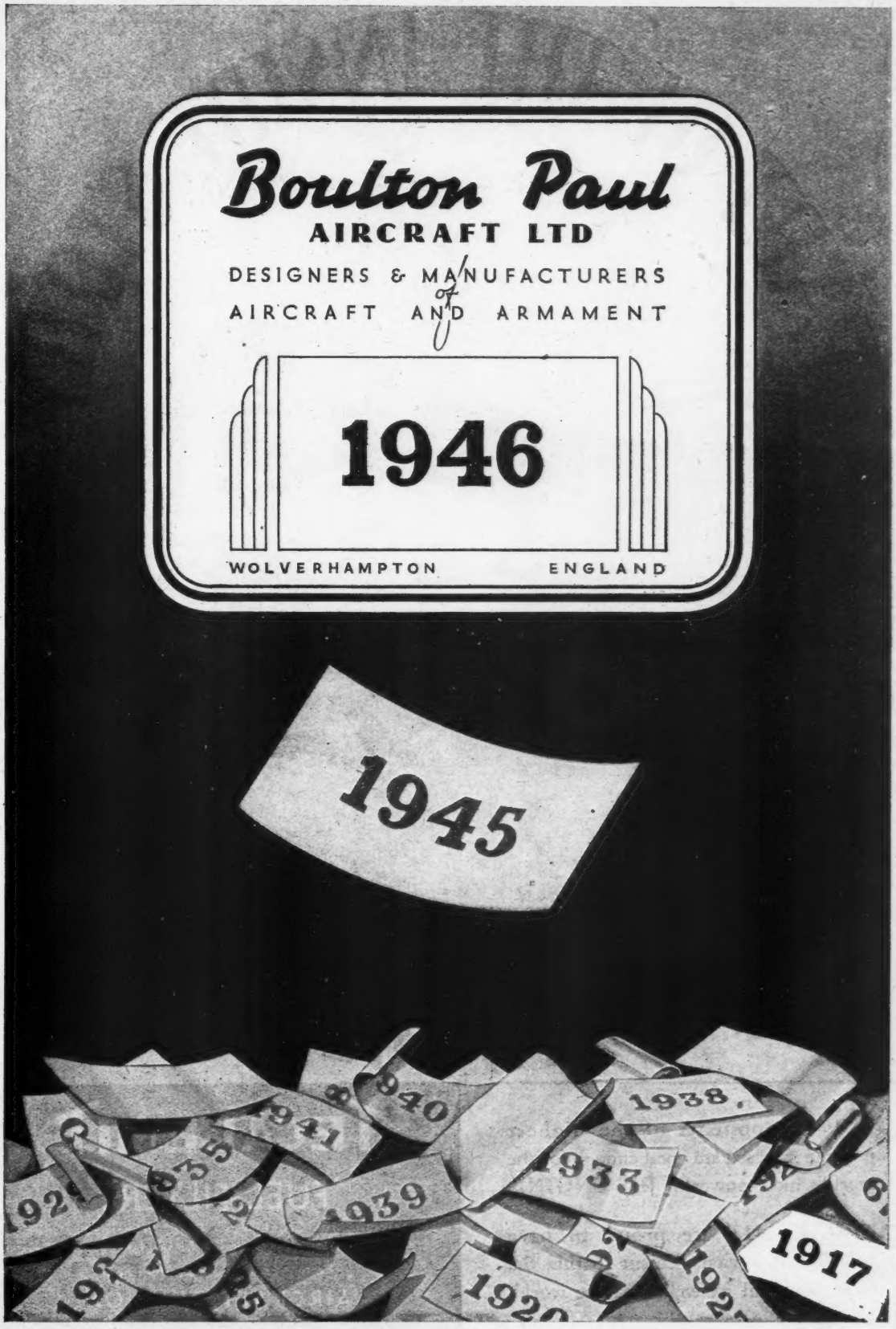
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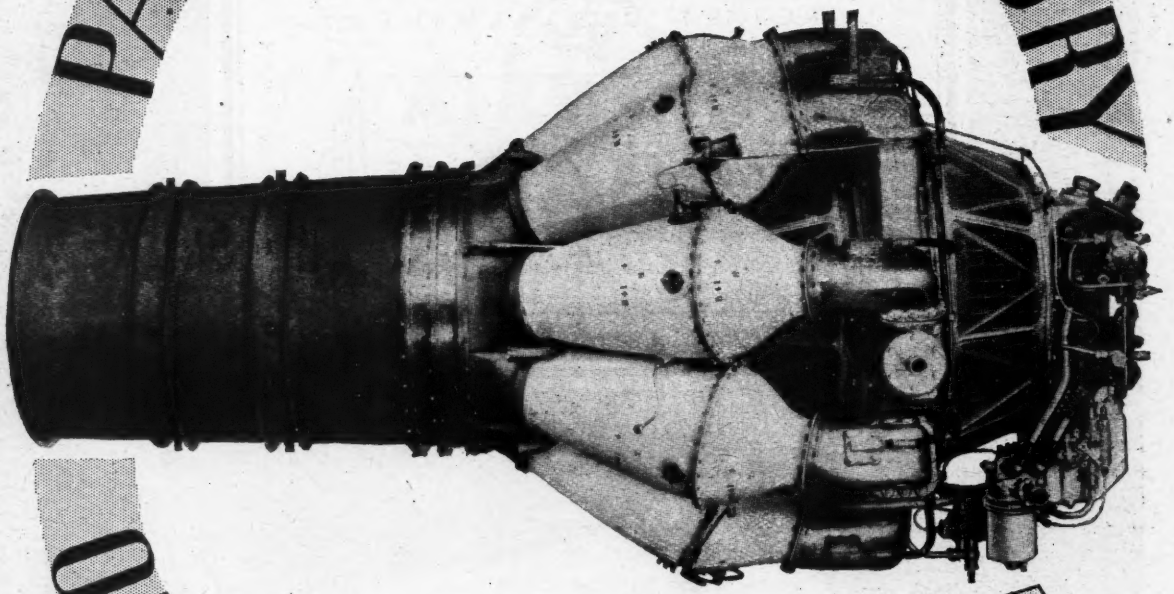

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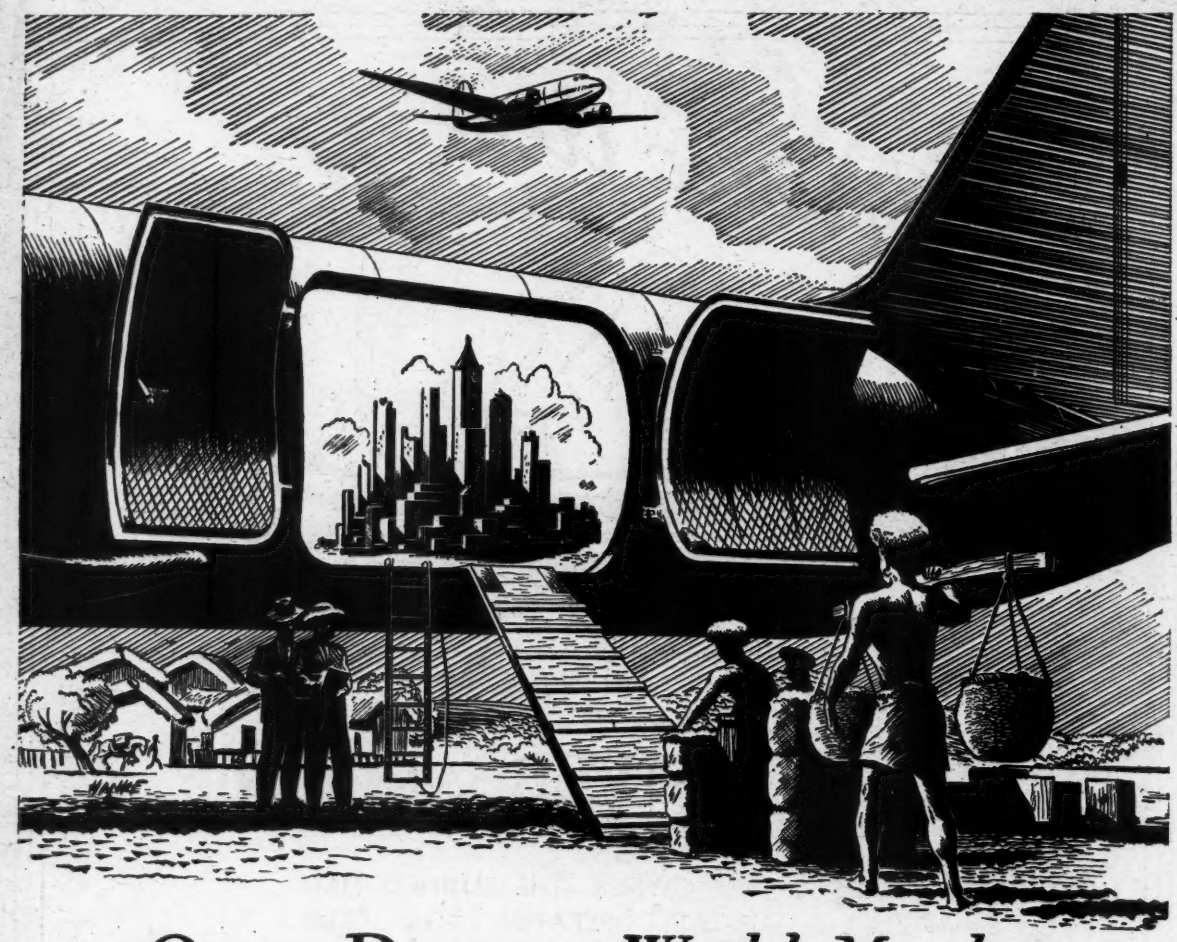

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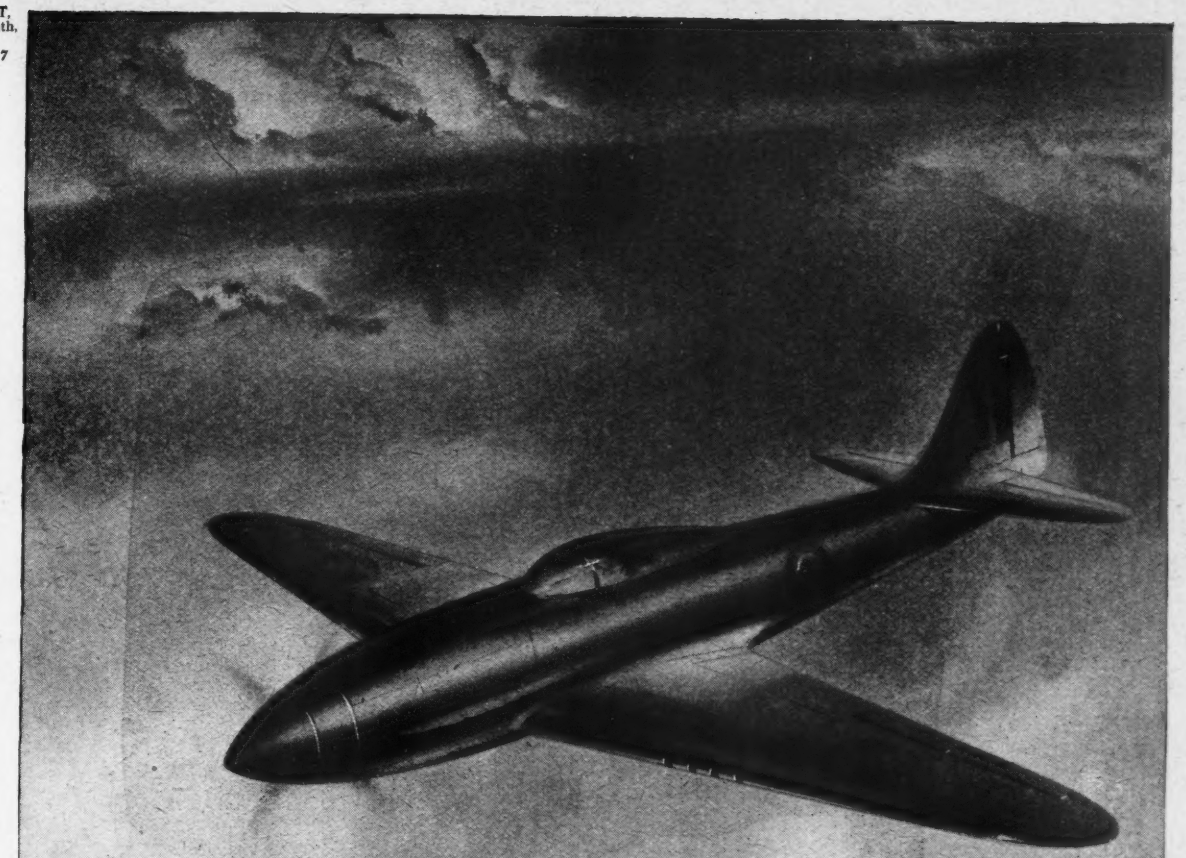

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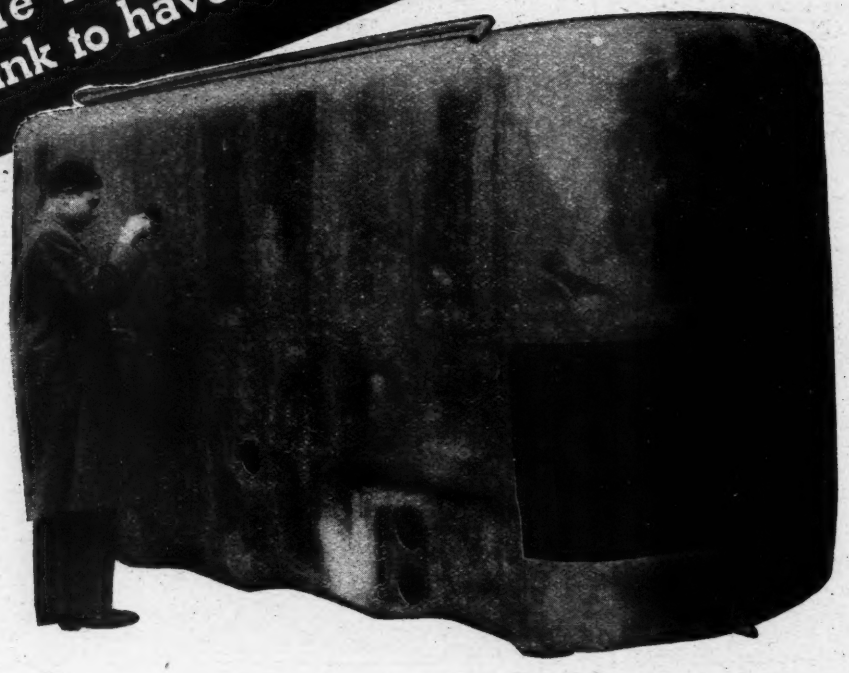

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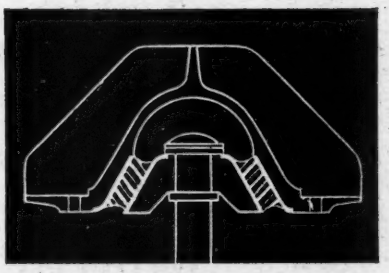

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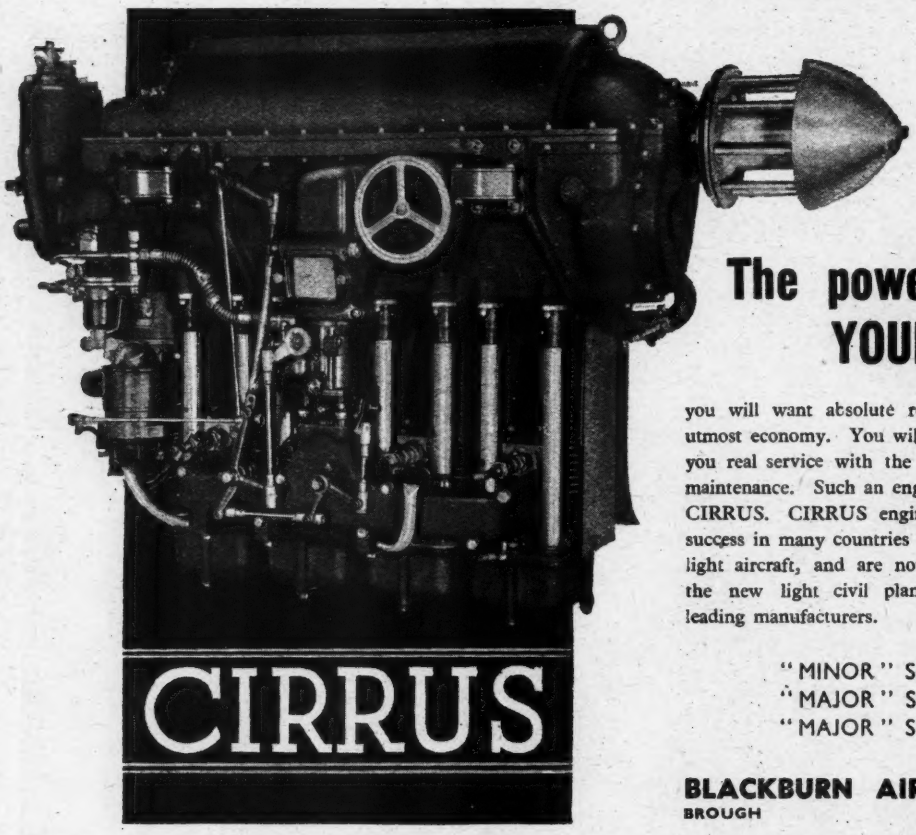

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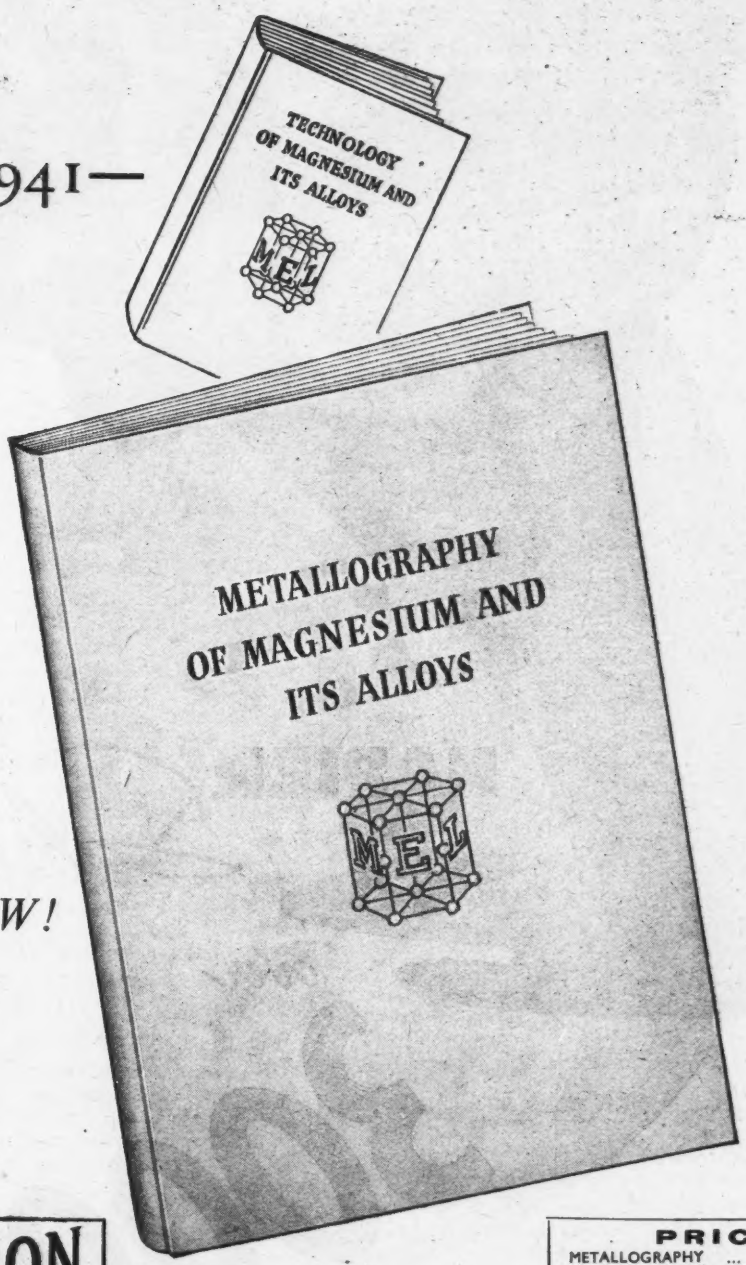

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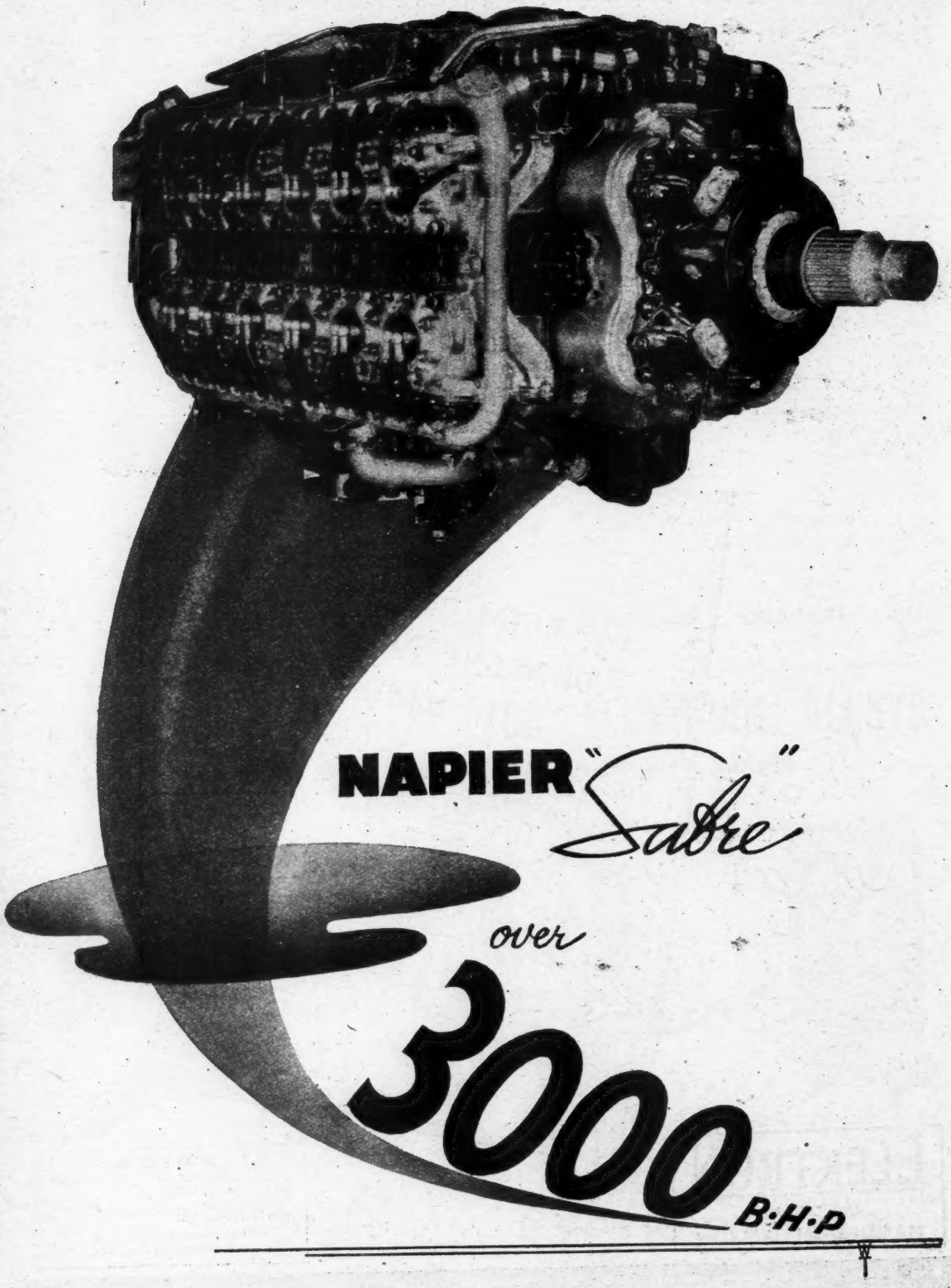

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The Outlook

This Pressurization

DURING the past year or so there has been a good deal of uninformed general comment on the subject of aircraft pressurization. The average member of the public has certainly learnt by now why such pressurization is necessary and, generally speaking, what it means. But the whole thing has usually been very much over-simplified, and just now people appear to have the idea that whereas we in this country are still floundering about in the "laboratory" stage, American citizens are already flying backwards and forwards in comfortably inflated civil aircraft.

It is probably quite true to say that one American aircraft is now being flown in service with its pressurizing equipment in action, but we believe that the differential is quite low, and certainly there is a very great deal more to be done in the way of humidifying and air conditioning. And, if one must be pointed, it may be said that, over here, the production Tudor I has, for some time, been flying on test with a 5½lb differential.

The trouble is that plain pressurization, difficult though this may sometimes be to organize, is only a part of any necessary system. On both sides of the Atlantic work is proceeding on refrigeration and humidification, and no one can claim yet to have solved the problems completely. Even pressurizing alone becomes progressively more troublesome as size and cubic capacity increases. Whereas a reasonable rate of leak over small internal areas can easily be overcome by the available pressure supply, this same rate can become quite impossible when it is being experienced over a very large interior surface area. The "caulking" must, consequently, be much more thorough, the possibilities of leakage are considerably greater.

The larger the aircraft, therefore, the more difficult the problem becomes—yet pressurization by itself is only one of the requirements in high-altitude air-conditioning.

Noises Off

EVEN when we have solved the problems of pressurization and air conditioning, there will remain another troublesome teaser—the reduction of noise. That this is far from being easy was made abundantly clear by Dr. N. Fleming in his lecture to the Royal Aeronautical Society last week, when he spoke on the subject of the silencing of aircraft.

So far as the noise which reaches the passenger is concerned, the very provision of a pressurized cabin must help in reducing noise; the fact that there can, for reasons of airtightness, be no cracks or openings in such a cabin is in itself a large contributory factor in noise reduction. Curiously enough, this fact was not stressed by Dr. Fleming. It may be accepted that an airtight cabin will not necessarily, by itself, suffice to give the desired decibel and phon scale reduction, but there would appear to be an opportunity for obtaining relative silencing at a rather lower additional weight if the cabin has to be pressurized. This may have the effect of encouraging the use of pressurization in classes of aircraft in which it would not otherwise be deemed to be absolutely essential.

As for silencing the noise at its source, the prospects do not appear very rosy. Not only piston-engine exhaust and airscrew noises, but those from the impellors and tail-pipes of jet engines are troublesome—just how troublesome we have hardly yet had time to discover. And even if these could be reduced by careful design, there must remain the noise caused by the passage of the aircraft itself through the air. With modern high cruising speeds this may become very noticeable if the noise level of other sources is successfully reduced. And what will happen when we come to supersonic speeds no one can foresee.

Altogether there is no risk that our designers will get rusty during the next few years. They have plenty of problems to keep them on their toes.

Bigger and Better

ALTHOUGH, at the time of writing, there is no truly official confirmation of the generally accepted statement that the Government has ordered three more Bristol 167s (or "Brabazons") in addition to the prototype, and three of the big Saunders-Roe boats, this is undoubtedly a fact. Presumably the orders are now on their way through the Ministry of Supply. The three 167s will consist of a prototype gas-turbine-powered version and two "production" aircraft of the same type; while there is to be a prototype Saro boat and two "production" aircraft to follow.

In *Flight* of March 14 we commented on the general situation so far as the Bristol 167 was concerned, and suggested that, if work was really to proceed on this project, it should be on a very high-pressure scale. For each of the firms concerned the task will be immense. Not only are we dealing with sizes greater than any previously contemplated, but the aircraft are being developed around new power units. Except in the matter of pressurization the designers of the flying-boat have a slightly less troublesome time ahead of them, since a flying boat can be scaled-up with a good deal of assurance, but there will be little room for any control or stability errors in either design. By the year 1951 we should have learnt a very great deal more about turbine installation, undercarriage loadings, large-volume pressurization, and powered controls. On technical grounds alone the experimental development work should, in knowledge gained, have paid for itself.

The possibility that something like two million pounds will need to be spent at Filton airfield before the prototype 167 can be completed and test-flown is more than distressing. But it should be a salutary lesson both for the Government and the aircraft industry. A great many of the present contractors' airfields are far too small and too badly placed for safe use by modern aircraft. Before it is too late the entire position, from this point of view, should be reconsidered and the necessary action taken. The development of our civil and military aircraft will otherwise be hampered, delayed and made immensely more expensive than necessary. We remember an occasion during the war when the chief of one of our shadow factories was shocked and incredulous when he was told firmly by his chief test pilot that the first of the firm's new bomber series could not, repeat not, be flown out of the tiny field which had previously been used, at considerable risk, for the production fly-offs of very much less heavily loaded types.

The work ahead of the industry will be sufficiently hard without the addition of any further complications.

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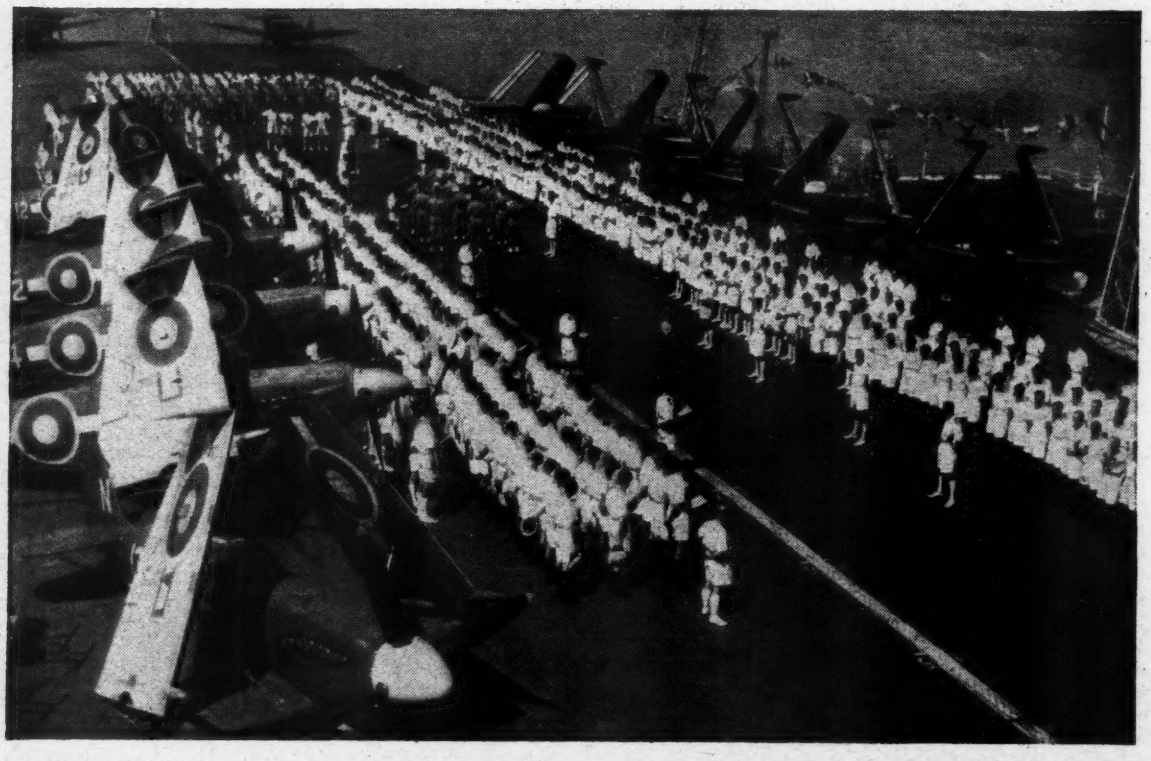


SUNDAY DIVISIONS: Flanked by Seafires, the ship's company of the aircraft carrier H.M.S. *Implacable* attend Divine Service on the flight deck while the ship is in Melbourne harbour.

The Blackburn B.20 on the water, with planing bottom and wing-tip floats lowered. The floats could be operated together or independently.

A Teaser in Hydraulics

Equipment Used for Operating the Pontoon, Wing-tip Floats and Other Services on the Blackburn B.20

By H. P. HENRY

PARTICULARS have lately been released of a very interesting flying boat built by Blackburn Aircraft at their Dumbarton factory just before the war. The outstanding feature was the provision of a hydraulically operated retractable step or pontoon, designed to give the airscrews adequate clearance from the water during take-off, but arranged to close up in flight. As will be seen from the photograph, a slice (4ft 8½in) has been taken out of the hull depth, which considerably reduces the overall drag of the boat with the pontoon retracted.

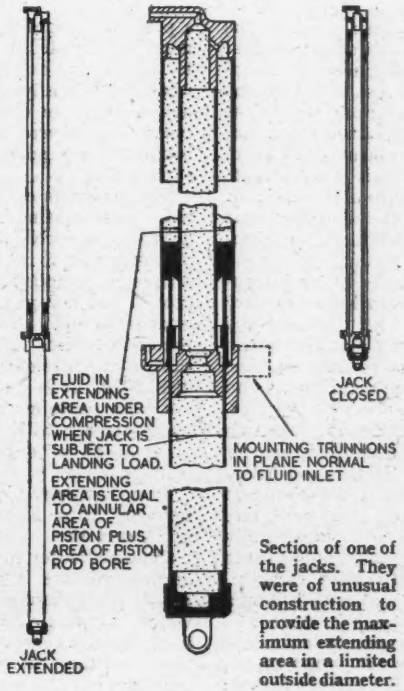
When Maj. Rennie, chief seaplane designer of Blackburn Aircraft, first approached Lockheeds in 1936, the problem seemed almost insuperable with the hydraulic equipment which was at that time available.

Briefly, the requirements were, to raise and lower the planing bottom which carried all the fuel load whilst in flight; to raise and lower the complete hull on and off the pontoon whilst on the water to allow for servicing, and to enable the hull to be raised in the event of a forced landing with the pontoon retracted; to lower the pontoon by gravity in the event of engine failure. Finally, as the jack and mechanism layout was envisaged, the jacks had to take the full dynamic landing load, just like the shock-absorbing struts on land aircraft, but, of course, without closing.

One of the major difficulties was the synchronization of the 55ft pontoon end-for-end. Limitation of hull space and structural considerations made it essential to position the jacks about a third of the way along the upper deck of the pontoon deck, which left an overhang of more than 17ft at the rear of the pontoon.

Any appreciable out-of-phase or lack of synchronization between the front and rear jacks would result in the stern or bow of the pontoon striking and damaging the hull before the jacks came on to their stops.

The problem was further complicated by the asymmetric loading of the jacks, particularly front to rear. This was due to the fuel being carried in four separate tanks in the pontoon hull, and to the aerodynamic loads. The magnitude of these load differences precluded mechanical synchronization front to rear, but it was found possible to make frames to carry any lateral difference. So it was decided to concentrate on a hydraulic synchronizing gear to take care of the fore and aft load differences and to tie the jacks together across the hull, i.e., port front to starboard rear and starboard front to port rear.


FLUID IN EXTENDING AREA UNDER COMPRESSION WHEN JACK IS SUBJECT TO LANDING LOAD.
EXTENDING AREA IS EQUAL TO ANNULAR AREA OF PISTON PLUS AREA OF PISTON ROD BORE
JACK EXTENDED
JACK CLOSED
MOUNTING TRUNNIONS IN PLANE NORMAL TO FLUID INLET

Section of one of the jacks. They were of unusual construction to provide the maximum extending area in a limited outside diameter.

Jack Synchronization

A synchronizing valve was designed and developed which was connected to each pair of jacks by a light cable. Referring to the drawing, it will be seen that if the forward jack tends to lead going down, the cable will be tightened and the valve will move over to seat "A," cutting off the fluid. This valve arrangement has the advantage that it works in both directions and can be developed to be extremely sensitive. During tests on the boat before flight, a very sensitive clinometer placed on the deck showed no bubble movement

A TEASER IN HYDRAULICS

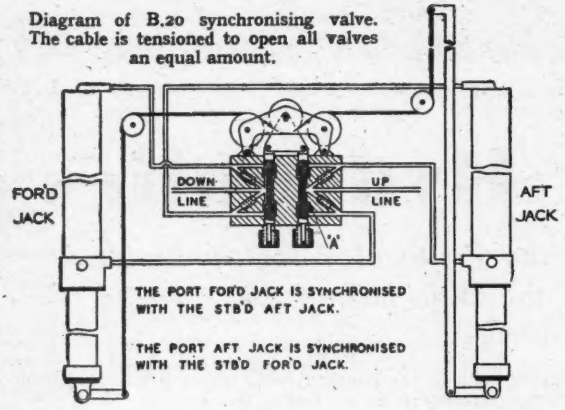
whatever once the valves had taken up position one way or the other to compensate for load differences in the jacks. This initial differential movement was only of the order of $\frac{1}{32}$in in the jack stroke of nearly 5ft.

The jacks themselves (see p. 383) were of unusual construction to provide the greatest possible extending area in a limited outside diameter to cater for the landing case. Retracting loads were a secondary consideration.

A hydraulic lock valve was fitted as close as possible to each jack to limit the length of piping subject to the fluid pressure generated by landing loads. An ultimate structural factor, C.P. forward, of 6 resulted in a 52,100 lb end load in each of the front jacks. These each had an area of 20.56 sq in, so the ultimate pressure to which the jacks and valves were designed was 2,540 p.s.i. This involved considerable research, as at that time (1938-9) the normal operating pressure was only 1,400 per sq in.

A collapse valve was incorporated in the hydraulic lock-valve so that, in the event of engine stoppage or failure of the two hydraulic pumps, the pontoon could fall under its own weight after the pilot had selected "down." This collapse condition was also difficult to cater for, because the pontoon carried the total fuel load of 760 gall, weighing 5,700 lb. As the pontoon itself only weighed 2,200 lb, there was a wide weight variation to cater for during the tall. Further, owing to the large "down" area required to support the landing loads, each jack had to draw in 4.45 gall of fluid during lowering.

Diagram of B.20 synchronising valve. The cable is tensioned to open all valves an equal amount.


FOR'D JACK
DOWN LINE
UP LINE
AFT JACK
'A'
THE PORT FOR'D JACK IS SYNCHRONISED WITH THE STB'D AFT JACK.
THE PORT AFT JACK IS SYNCHRONISED WITH THE STB'D FOR'D JACK.

Retractable Floats

Each of the wing-tip floats was operated by a hydraulic jack, with a separate lock to hold them in the retracted position. Separate selector valves, with the levers mechanically joined, were provided for each float so that they could be retracted simultaneously during take-off, as soon as the boat had lateral control, and could be operated independently for servicing purposes when on the water. If two or three members of the crew go out to one wing tip the opposite float is clear of the water and can be retracted.

The rest of the hydraulic system was of the well-known cut-out-accumulator type. There were a number of other hydraulic services, including flaps, bomb doors, radiator shutters and flare chutes. Successful experimental flying was cut short when the boat was lost due to a flying accident and, as this type of retractable bottom is only seen to its best advantage in small and medium-size flying boats, it is unlikely that this highly ingenious arrangement will be developed any further.

Turbine-Jet Pioneers Resign

Original Team Disbanding as Result of New Policy

CONSIDERABLE prominence has been given in the daily Press to the decision of sixteen of the original Midland team of jet propulsion engineers to resign from Power Jets Limited. That all was not well with the gas turbine pioneers would be gathered from the recent resignation of Air Commodore Frank Whittle which followed a year or more after the Government decision to acquire the remainder of the shares of their small private company and to transform the works into a Government Research and Development centre. At the time there was much speculation as to the real cause of Whittle's resignation from the board, but as he is a serving officer no explanatory statement was forthcoming. It now transpires, however, that Whittle and his team desired to carry on a continuing policy of development with the loyal and enthusiastic men he had gathered around him and attain objectives with new and complete gas turbine engines. Investigations and small-scale research on components and theories do not satisfy their ambitions.

The Government policy with all engineering research centres is to pass to manufacturers the benefit of their investigations and scientific discoveries. Such is the policy being applied to Power Jets Research and Development Ltd., now that the Government has acquired the share holding of the original company, at a figure incidentally that caused much heartburning among the enterprising band of private enthusiasts who financed Whittle's original project in less promising days. It is understood that a figure of £3 2s 6d was paid for each original £1 share.

It is the orginal team of engineers who are most aggrieved at the turn of events. Naturally they are proud of the successful outcome of their efforts to make the gas turbine a practical proposition. Years of patient work and experiment were needed to bring the turbine to success. Its value to the country cannot yet be assessed. Their early labours were not officially supported; even many aircraft technicians who are to-day enthusiastically in favour of turbines were severe critics while the laborious process of evolution was going on and one obstacle after another surmounted.

The engineers engaged at Power Jets became a devoted team collaborating night and day in their strenuous endeavours to evolve under Whittle's guidance the new form of power unit in which they all had abiding faith. Their mission accomplished, and Whittle gas-turbine principles proved and accepted, the gradual diversion of orders and work on complete engines to recognized manufacturers has become a source of keen disappointment. They consider that so much remains to be done. Now the team is being disbanded. It is understood that only two of the sixteen are going on to aircraft engine work; some have obtained appointments with industrial turbine manufacturers in other fields of engineering, and should prove valuable recruits.

It is, however, to be regretted that such a loyal "reactionary" team of turbine specialists should have to split up in this way. Gas-turbine technology was new; testing technique for jet propulsion unknown at the time of the original venture. The installations had to be evolved at Power Jets by study and experiment, and have since been widely adopted. The team feels that their pioneer work in the British cause has earned them no credit or consideration, and they prefer private enterprise to State-controlled activities.

India's Air Pageant

AT WILLINGDON AIRPORT

Over 100 R.A.F. and R.I.A.F. Aircraft Take Part in Delhi Victory Week Display

Lancasters passing over the airfield in formation during the final fly-past.

MORE than 100 aircraft of the Royal Air Force and the Royal Indian Air Force took part in the recent "Victory Week" air display at Willingdon airport, Delhi, which was attended by the Viceroy, Lord Wavell, and Lady Wavell, the C.-in-C., Sir Claude Auchinleck, and the A.O.C.-in-C., Air Marshal Sir Roderick Carr. The occasion was generally agreed to be the greatest air display of its kind ever staged in India, and was watched by a crowd estimated at well over 100,000 people.

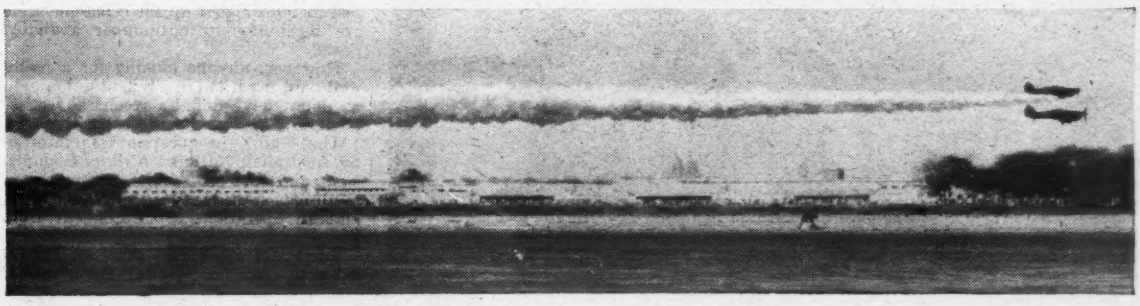
There was plenty of variety in the two-hour programme, for more than 20 different types of aircraft were represented, ranging from "grasshoppers" to four-engined bombers, and after the actual flying diplay was over, all the types which had taken part were parked where the general public could enjoy a close-up view of them. There was also a very comprehensive exhibition of Air Force equipment, and a display of up-to-date R.A.F. and R.I.A.F. training methods.

The flying programme opened with an impressive series of take-offs from the airstrip by Harvards and Beaufighters, Thunderbolts and Mosquitoes, immediately after which an R.I.A.F. Spitfire Wing flew over in formation. Then five Harvards put on a neat aerobatic act which was followed up by one of those comedy turns without which no air display can really be considered complete—namely an exhibition of crazy flying executed at zero feet. In this instance the slightly perilous fun was provided by the pilot of a Tiger Moth, whose antics contrived to suggest, very cleverly, that he was trying to imitate the Harvards after a too lengthy sojourn in the mess.

Combined Operation

The crowd next saw a pair of Spitfires engaged in a mock battle with a Lancaster, and a Hurricane sending its blazing rocket projectiles into a ground target. This brought the proceedings to the main item on the programme, a full-scale asault on an "enemy factory." The target was first photographed by Mosquitoes, then bombed by waves of Lancasters, after which Dakotas dropped parachute troops who, under cover of a smoke screen laid down by two Hurricanes, stormed what was left of the objective. This was a very well-timed exercise and gave the spectators a realistic impression of a phase of modern warfare—the combined operation in khaki and light blue.

At intervals during the proceedings a Tempest roared over the heads of the crowd at high speed and zoomed upwards in demonstration of its terrific rate of climb, and the Naval Air Arm contributed to the programme with Barracudas and Corsairs. The display ended with a mass fly-past of all the aircraft taking part in the programme.



Hurricanes lay a smoke screen to cover the assault on the "enemy factory" by paratroops, after a thorough "softening up" by Lancasters.

GLOBEMASTER: The U.S.A.A.F. version (C-74) of the Douglas DC-7, 26 of which have been ordered by "Pan Am" for transatlantic service. It is powered by four 3,000 h.p. Pratt & Whitney Wasp Majors.

Transatlantic Babes

NEW regulations recently introduced by T.C.A. have removed the previous restrictions on the carriage of children on transatlantic flights, and passengers between the ages of two and twelve years of age will in future be carried at half fare; they must, however, be accompanied by a passenger of at least twelve years of age.

Such juvenile passengers will be entitled to the full baggage allowance of 66 lb on the Canadian-built Lancastrians operating the 14-hour service between Montreal and Prestwick.

Rain or Fine

THE Bushey Park Model Flying Club is not one of those fair-weather organizations; moreover, it has courage. This is evident from the announcement that its Easter Sunday gala day competitions on Hounslow Heath for rubber-driven and petrol-powered model aircraft will be held "whatever the weather conditions," starting at 11 a.m.

Knowing the sort of weather we *can* have at Easter, we applaud the club's spirit—but we'll pray on its behalf for no gale warning, all the same!

A Light Blue Affair

EX-STAFF, ex-members, and ex-cadets of the Cambridge University Air Squadron (who number some 3,000) are invited to roll up on the occasion of the squadron's 21st anniversary dinner which is to be held at the University Arms Hotel on the evening of Friday, May 24th, and if they all turn up it should be quite a party!

The occasion is part of a big effort to get the squadron going again on a peacetime footing, and we hear that the Secretary of State for Air and the Chief of Air Staff will be there to give their official blessings.

Anyone desiring more information should write to Wing Cdr. Nigel Bicknell, Cambridge U.A.S., Fen Causeway, Cambridge.

NOBLE ANCESTOR: A model of the 1931 Schneider Trophy winner, the S 6B, was one of the main attractions at the "Tribute to Genius" exhibition recently opened in Regent St., London, in aid of the Mitchell Memorial Fund. Flt. Lt. now A.V-M., and Assistant Chief of Air Staff) J. N. Boothman won the trophy outright for Great Britain at an average speed of 340.08 m.p.h.

HERE &

Peacetime A.T.C.

CHOSEN as one of the permanent post-war A.T.C. squadrons, No. 1268 (Haslemere and District) Squadron enjoyed a special occasion last Saturday when its new training headquarters adjacent to the Drill Hall, Haslemere, were opened by Air Marshal Sir Leonard H. Slatter, A.O.C.-in-C. Coastal Command, R.A.F. Among the guests of honour were Air Chief Marshal Sir Sholto Douglas and Sir Harry Brittain.

This A.T.C. squadron was formed in March, 1941, and, in addition to its local membership, drew recruits from the outlying villages on the borders of Surrey, Sussex and Hampshire.

Under its first and only C.O., Flt. Lt. H. W. Oatley (a pilot of the 1914-18 war), it soon grew to its present five flights, and altogether some 400 cadets have passed through its ranks. Present strength is about 70 cadets.

No "Clubsidy" Yet

"THERE is no proposal at present to give financial assistance to gliding clubs," said Mr. Ivor Thomas, Parliamentary Secretary to the Ministry of Civil Aviation in the Commons recently.

"As gliders become available," he added, "the matter will be considered, but meantime a few German gliders which are available will be lent to clubs through the British Gliding Association for test purposes."

It does not do to interpret Parliamentary replies too logically, but the general tone of Mr. Thomas's statement would certainly seem to imply that a hope (however distant) of some kind of Government help for the gliding clubs may possibly exist. Or are we *still* being too rash?

Nice Work—

BRICKLAYERS and window-cleaners may still be in short supply, but already there are signs that those qualified for jobs higher up the economic scale are beginning to outnumber available posts.

However, anyone looking for a really well-paid position in civil aviation will no doubt have found a recent advertisement in *The Times* quite attractive.

The "ad." in question was inserted by Australian National Airlines Commission, and was for a chief engineer at a minimum starting salary of £2,000 p.a., and an operations superintendent from £2,250 p.a.

Successful applicants must be British subjects, pass a medical examination, and will have to "make and subscribe an oath or affirmation of allegiance . . .", and anyone who fancies his chance should telegraph brief particulars about himself to the chairman of the Commission. Box

& THERE

No. 2806AA, Post Office, Melbourne, before April 26th, and follow up with the full gen in writing "as soon as possible thereafter."

Chivalrous Captors

THE story of Flt. Sgt. A. W. Davidson, whose Thunderbolt was shot down by Indonesian A.A. fire last December, and who was returned safely to Batavia last week, makes unexpectedly pleasant reading.

This young R.A.F. pilot parachuted to earth wounded, and the Indonesian civilians and military "extremists"

TAXI ! Miss Phillipa Bennett, a pre-war B licence pilot who served in the A.T.A., has started an air taxi service at Southampton Airport with two Wicko aircraft.

among whom he landed at once sent for a doctor and had him removed promptly to hospital among their own wounded. Here he was extremely well treated and, when sufficiently recovered, became the "guest" of one of their senior officers, who promised him a post-war job as instructor to the Indonesian Air Force.

The flight-sergeant is reported to be considering this offer.

AIRSTRIP . . . No. 10

VICTORY WEEK at Delhi was celebrated by a great air display by the R.A.F. and R.I.A.F. (see page 385) at Willingdon Airfield, at which one of the major thrills was provided by the high speed flying of this Tempest, here seen taking off.

News in Brief

THE Air Training Corps is staging the fourth National Boxing Championships at Belle Vue, Manchester, on May 20th. The programme of events will include a contest for the *Flight* Cup.

* * *

Cpl. Sidney Burgess, of No. 84 Group R.A.F. Police Unit, has the distinction of being the first mounted R.A.F. policeman to be seen in Germany. His "beat" is among the tangle of horse-drawn local traffic in Hanover.

* * *

Past and present members of No. 35 (Recce) Wing, No. 84 Group, R.A.F., will be interested to learn that it is proposed to hold a reunion dance in London next September. Mr. B. Edwards (ex-Flt. Lt.), of 18, Crown Lane, Morden, Surrey, has been appointed secretary.

* * *

Mr. Oswald Short, honorary life president of Short Brothers, has sent £1,000 to Field Marshal Viscount Montgomery as a contribution to the Newspaper Press Fund, at whose festival dinner Viscount Montgomery will preside at the Dorchester Hotel on May 29th.

* * *

It is proposed to arrange reunion dinners for ex-members of the permanent staff of the R.A.F. station, Mount Hampden, Southern Rhodesia, from 1941 to 1945, and those interested should write to Flt. Lt. C. Nepean Bishop, c/o The National Provincial Bank, 10, Marylebone High Street, London, W.1, and give their private addresses.

* * *

The Soviet Aviation Sports Commission, headed by Col. Gen. Mikhail Gromov, is co-ordinating the formation of flying clubs throughout the U.S.S.R., and is to promote flying, gliding, and parachute jumping, as a nation-wide movement. "We have many means for establishing world air records, and we must utilise these possibilities," said Gen. Gromov to a *Reuter* representative recently.

* * *

Speaking at the annual meeting of the Institution of Naval Architects in London last week, Sir Stanley Goodall, vice-president, said that air attack was more deadly to the smaller type of ship, and that aircraft carriers did not have such effective protection against underwater attack as did capital ships owing to their lesser displacement.

* * *

Group Capt. William Roy Maxwell, the Canadian pioneer bush pilot who joined the R.F.C. in 1917 and who, during the recent war, served in No. 1 Training Command and at Western Air Command headquarters, R.C.A.F., has died in Toronto at the age of 52.

* * *

The Handley Page slotted wing American patents have been purchased by the U.S. Navy on behalf of the American Government. Curtiss-Wright and other U.S. aircraft manufacturers used this safety device during the war, and, by various arrangements, the H.P. slotted wing has been incorporated in aircraft built in nearly every country in the world.

* * *

Just as we go to press we hear a rumour that Armstrong Whitworth's chief test pilot, Flt. Lt. Charles Turner Hughes, is leaving them.

"Indicator" Discusses Topics of the Day

In Praise of Ourselves

The Air Speed Record Situation : What We Have in Hand : The Jet Fuel Question

A SOMEWHAT uneasy silence appears to have fallen on the American air-speed record experiments. Presumably development work is still proceeding, while technicians do their best to find some means of superficial re-design which will put up the Mach number on the P-80 and permit it to make use of the available thrust.

Certainly, judging from all that one hears, the Shooting Star appears to be quite an exceptionally good aircraft up to its natural limiting speed—which is probably in the region of 570 m.p.h. with its present intake arrangements and general shape. The few British pilots who have flown it are enthusiastic about its handling qualities at all speeds up to this limit, whatever it may be, and certainly about the technical perfections of its various electrical and other installations. But there seems to be no doubt that, unless the various "shapes" can be suitably re-designed, there is not much hope that speeds of the record-breaking order will be possible, whatever thrust may be available. Apart from any control peculiarities at high Mach numbers, the standard P-80 appears to run into a "wall" soon after the critical number has been reached.

In the meantime—and so that our friends across the Atlantic may not feel less than the appropriate amount of despondency to match our own in matters of immediate civil aircraft production—it might be as well to say a word or two about our own high-speed position. One way or another the basically five-year-old Meteor appears to be very much more than holding its own in the matter of sheer performance.

Even at the time of the record attempt at Herne Bay, the pilots certainly seemed to be quite confident that the record could have been safely broken by a very much greater margin had more thrust been laid on. Development flying by Glosters appears to have effectively shown that, even if the Americans were to be successful in jumping our record claim by the requisite amount, we could ourselves go right ahead and improve at least on any reasonable figure which may be set up. And unreasonable speeds can hardly be expected at this stage of aircraft development.

Present Prospects

In fact, were it not for the considerable amount of expensive and time-wasting organization required before any intermediate attempt on the record, this could now be handsomely re-broken—and at a figure which, it is reasonable to suppose, would considerably exceed that so pleasant round figure of 1,000 kilometres an hour. This after all, is only a matter of 621.4 m.p.h., and casual gossip puts the Meteor's possible level maximum at 630 m.p.h. or more.

It would certainly be rash to make a guess at the handleable maximum of which the Meteor is capable, but Mach numbers up to and over an order of 0.84 have already been reached on test with everthing in fairly good order. And there does not appear to be any shortage of available thrust from existing power units. This particular Mach figure, if the conversions produced by my guessing stick are not too wildly inaccurate, gives a sea level speed of 640 m.p.h.

Curiously enough, the Meteor's critical Mach number—that at which local airflow reaches the speed of sound—is about 0.76, yet no drag rise occurs even at a level speed figure equivalent to 0.80, and the introduction of the lengthened nacelles has also considerably improved the high-speed handling qualities. From all that one hears, there is no tendency for this particular aircraft to become nose-heavy, in the usual way, at high Mach numbers—in fact, the tendency appears to be rather the other way—and as a matter of interest even the production Meteor has the very high "official" design limitations of 600 m.p.h. for indicated air speed and 0.85 for the Mach number.

Of course, though all recorded high-speed figures are immensely useful from the propaganda point of view, the real value of the enormous thrusts which are now available for fighters lies in the very considerable increases which are possible in rates of climb for interception purposes. The ability of an aircraft to reach really high speeds and to remain under comfortable control at these speeds will always be vitally important in air warfare, but rate of climb appears now to be the priority target in fighter design. The highest fighter climb figure which has so far been publicly given is, in fact, that of the Meteor IV, which has a sea-level rate of 8,300 ft/min, and reaches 30,000ft in rather less than five minutes. According to calculations, the height at which a rate of climb of 500 ft/min can still be maintained is 53,000ft—which is not too bad for the time being.

The expression "according to calculations," in this case, brings one to another point in the fighter development story. Needless to say, nobody has been to 53,000ft in the Meteor or any other standard fighter; altitudes of such an order will not be practicable in normal operational flying until high-pressure cabins can be organized. Incidentally, I believe that the P-80, amongst its other ingenious and technically exciting features, has a device in the pressurization system by which this pressure is wholly or partly released when the gun buttons are set for "fire." The idea being to prepare the interior for any possible "strike" damage and too-sudden de-pressurization.

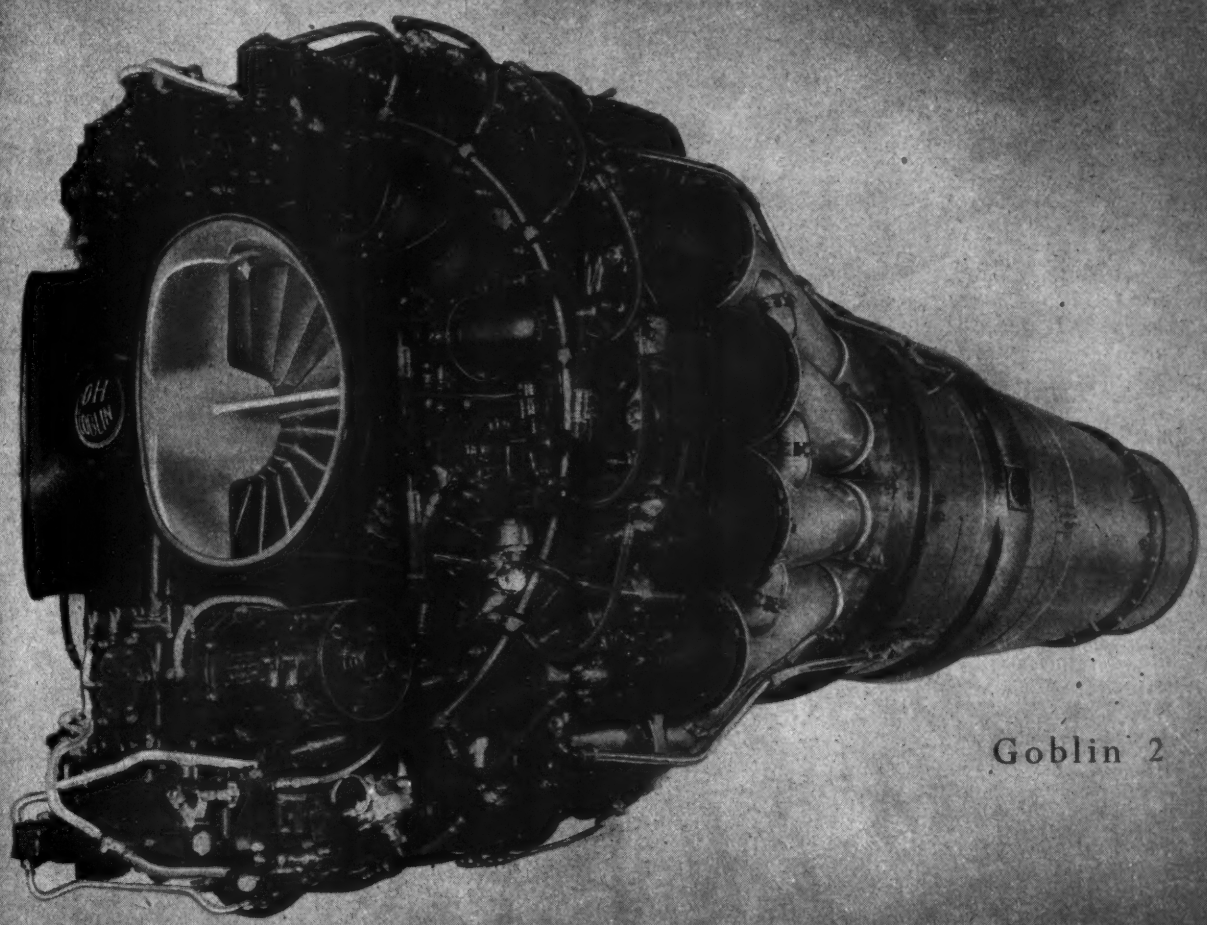
Fireworthiness

While on the subject of jet aircraft, there seems to be a tendency nowadays towards the idea of returning to the use of low-octane petrol rather than kerosene. Though I confess to partial ignorance of the various pros and cons, this does seem to me, as a superficial observer, to be a painfully retrograde step. In one fell swoop we seem to be throwing away the chance both of making aircraft a little less fireworthy and of improving consumption figures.

On the side of the supporters of the change-over there are, no doubt, a number of temporarily important advantages to be gained. We all know that trouble is being experienced with carburation—if it can so be called—at high altitudes, and that there is a tendency for the "fires" to go out in the consequent rich-mixture conditions. Furthermore, any re-lighting is problematical until the aircraft has returned to much lower altitudes—by which time the units are likely to be stone-cold and re-lighting is still not easy. The use of low-octane petrol would no doubt deal effectively with such faults.

It may eventually be decided that high-altitude combustion difficulties with kerosene cannot easily be overcome, and that the loss of fire-safety, and the increased consumption are worth while, in balance, for the advantages gained. But, on the face of it, there are surely some obvious ways out of the impasse. Experiments might be made, for instance, with a slightly more volatile fuel which could be carried in a separate tank and fed when necessary to the jets, with the normal fuel, under suitable barometric control. Again, a small petrol supply might be carried solely for relighting purposes. Nobody is going to tell me that our technicians are likely to be defeated by this or any other difficulty, and I certainly feel that we should stick to kerosene if it is at all possible to do so.

Power plant of the fastest single-engine fighter in the Royal Air Force



Goblin 2

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high-efficiency

JET ENGINES

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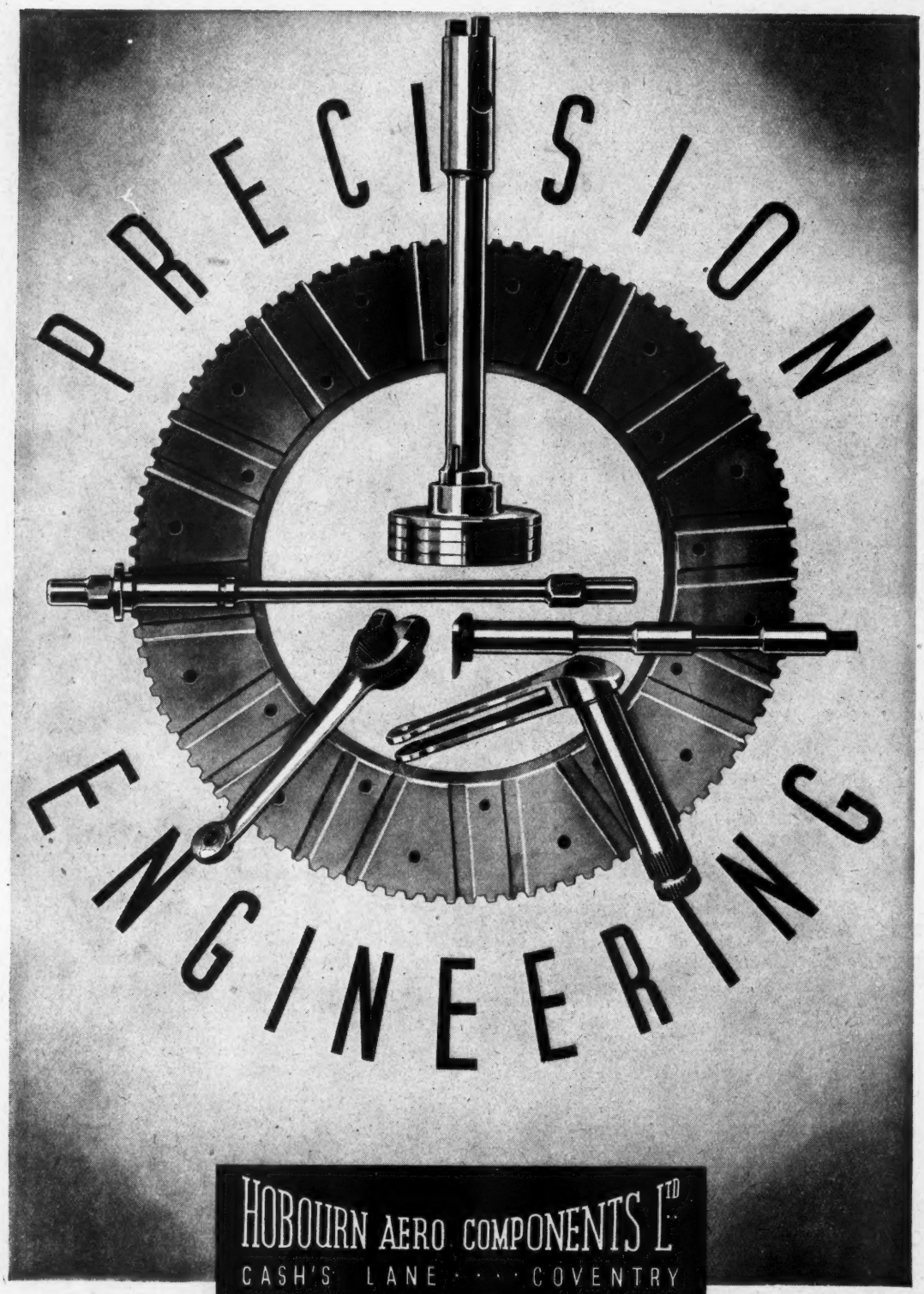
ENGINES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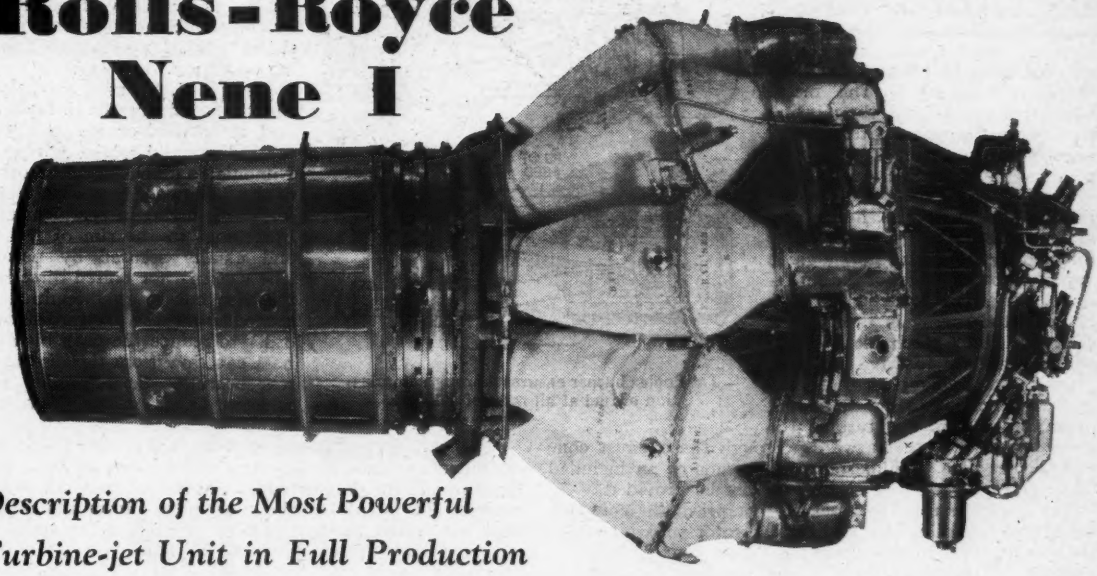
Rolls-Royce Nene I



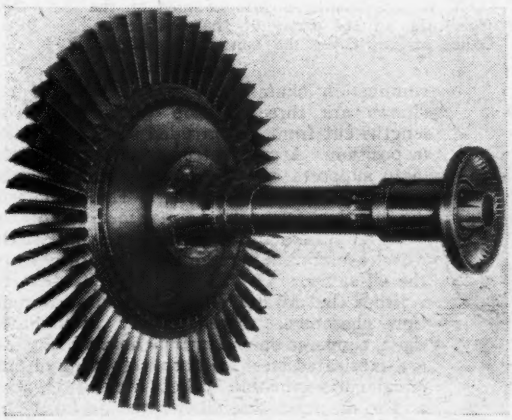
Description of the Most Powerful Turbine-jet Unit in Full Production

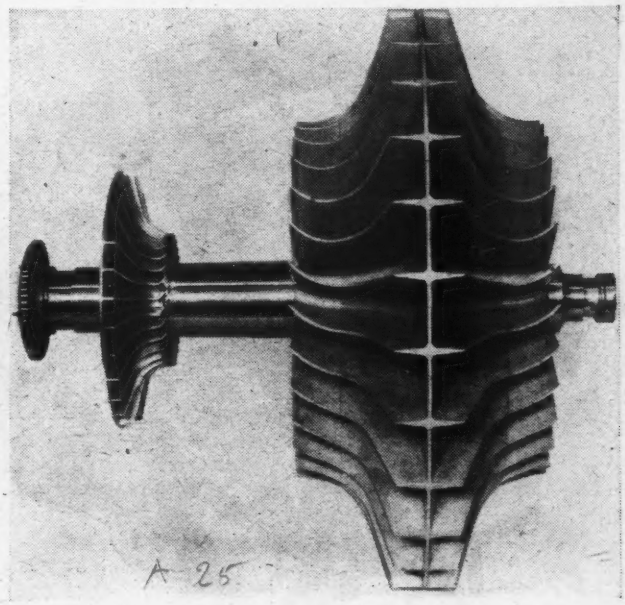
EARLY in 1944 the Ministry of Aircraft Production issued a specification for a jet-propulsion unit having a maximum overall diameter of 55in, a minimum static thrust of 4,000 lb, and a weight not exceeding 2,200 lb. The Rolls-Royce Nene I is the fulfilment of this requirement in generous measure. Units at present in production have a diameter of 49½in, develop a thrust of 5,000 lb, and weigh only 1,550 lb. Thus the realizable performance is 3.2 lb thrust per lb weight and 375 lb thrust per sq ft of frontal area instead of 1.8 lb and 242 lb thrust respectively as originally stipulated. Such figures are outstanding and are an eloquent assurance that Britain will not lightly relinquish the technical lead established in the development of the aircraft gas turbine.

The Nene is a turbine unit specifically for jet propulsion. In all main design features it resembles the smaller Derwent jet engine, but it would be incorrect to regard it merely as a lineal descendant of increased dimensions. When the specification was first presented the Derwent had been developed from the Mark I producing 2,000 lb thrust to the Mark IV having a thrust of 2,400 lb. The practicability of scaling up the Derwent was investigated, but to obtain the stipulated 4,000 lb thrust would have necessitated increasing the maximum diameter from 43in to nearly 60in. Consequently, a complete redesign was undertaken, and it was found that all requirements could be met with a diameter of only 49½in.

In the remarkably short period of 5½ months the design was completed, all drawings prepared, the first unit built and the proving run of one hour at 5,000 lb thrust successfully accomplished. It is understandable that in view of this achievement further development of the original Derwent design was regarded as relatively unfruitful, and accordingly the Derwent V was virtually a scaled-down version of the Nene I.

The single-stage, double-sided, radial-flow compressor of the Nene delivers air at four times atmospheric pressure to nine straight-flow combustion chambers. Aviation kerosene under high pressure is sprayed downstream into the chambers, to form a combustible mixture having an





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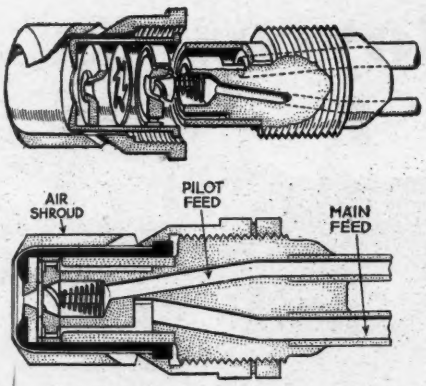
The main rotating components. Turbine rotor (left) and the compressor impeller and cooling-air fan (right). The central shaft coupling can readily be disconnected.

ROLLS-ROYCE NENE I

air/fuel ratio of about 18: 1, and burnt continuously. The major volume of air, diluting the mixture to a ratio of approximately 60: 1, is expanded by the heat released by combustion of the fuel.

From the rear ends of the combustion chambers the heated air and combustion products are directed by stationary nozzle guide vanes on to the blades of the single-stage, axial-flow, turbine rotor. Some of the energy in the gases is converted into mechanical power which is utilized to drive the compressor, directly coupled to the turbine, and maintain continuity of operation. From the turbine the gases are discharged rearwards through the exhaust cone and the jet pipe. The issuing jet spreads at an included angle of 15-20 deg. and clearance must be provided.



The duplex burner ensures thorough atomization of fuel at all rates of delivery.

The complete rotating assembly comprises the compressor impeller, cooling fan, and turbine rotor on two coupled shafts supported in three bearings. End bearings are of the roller type, whilst the centre bearing is a deep-groove ball bearing to support axial loads. It is of interest to note that at speeds up to about 8,000 r.p.m. the axial thrust is directed forward, but above that figure it is exerted rearward. Compressor and turbine shafts are connected by a quick-detachable spherically-seated coupling which enables the turbine rotor and shaft to be withdrawn for inspection without dismantling the structure. The ball transfers axial thrust but torque is transmitted by inter-engaging toothed elements.

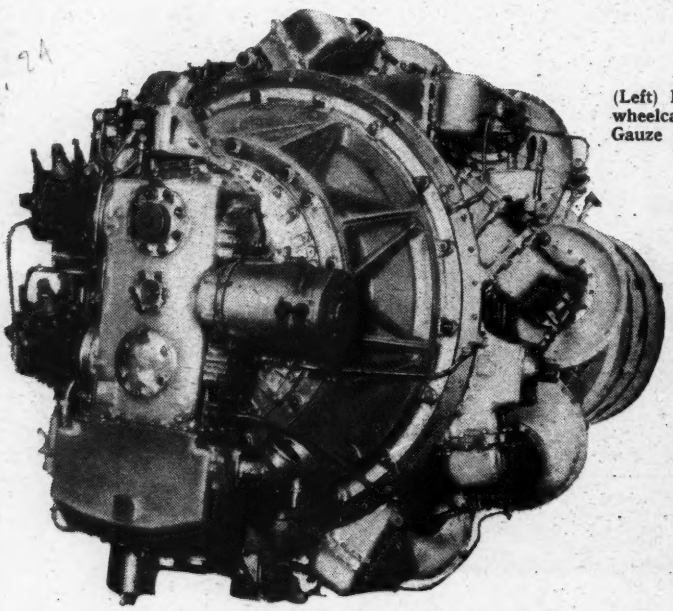
Impeller and Turbine

The impeller is 28.5in diameter and machined with 29 radial vanes each side from a single light-alloy forging. Curved entry vanes, approximately 17.75in diameter for each side, are separate components machined all over. On the 13in diameter cooling-air fan the 30 vanes have integral entry sections which are bent cold in two stages with an intermediate annealing operation.

Jessop's G.18B steel is employed for the solid forged turbine disc and, as on the Derwent, the blades are individually forged in Wiggins' Nimonic 80 alloy. Blade roots are of the "fir tree" type with tapered serrations fitting in complementary broachings in the rim of the disc and axially secured by peening. The shaft is not bolted directly to the disc but to an integral flange spaced from the forward face in order to reduce the path by which heat can flow from the disc to the rear bearing. Serrations on shaft and disc flanges relieve the bolts of all shear stresses.

The compressor casing is built up of front and rear members attached to a central diffuser ring by bolts passing through the diffuser vanes and the intermediate splitter vanes. To facings at the nine outlets from the diffuser ring are bolted the cast elbows conducting the air to the combustion chambers. In the bend of the elbows are three cascade vanes formed of lengths cut from an extruded section and cast in position. A pair of trunnions providing the main supports for the complete unit are also mounted on the diffuser ring. The front bearing housing forms the outer member of the front air intake and also serves to support the wheelcase containing the auxiliary drives and the oil sump.

(Above) Component parts of a combustion chamber. A complete assembly is shown on the right.



(Left) Engine auxiliaries are mounted on the wheelcase on the front of the compressor. Gauze screens cover the compressor intakes.

From the diffuser elbows the nine combustion chambers, spaced evenly around the shaft, converge on the turbine nozzle box. This is a fabricated steel member, consisting of nine circular-to-segmental sockets welded together and to an outer shroud ring and an inner ring which supports the cooling air manifold. Later a cast-iron nozzle box, similar to that used on Derwent V, will be provided. The 54 nozzle guide vanes are individually precision cast by the "Austenol" lost-wax process. When

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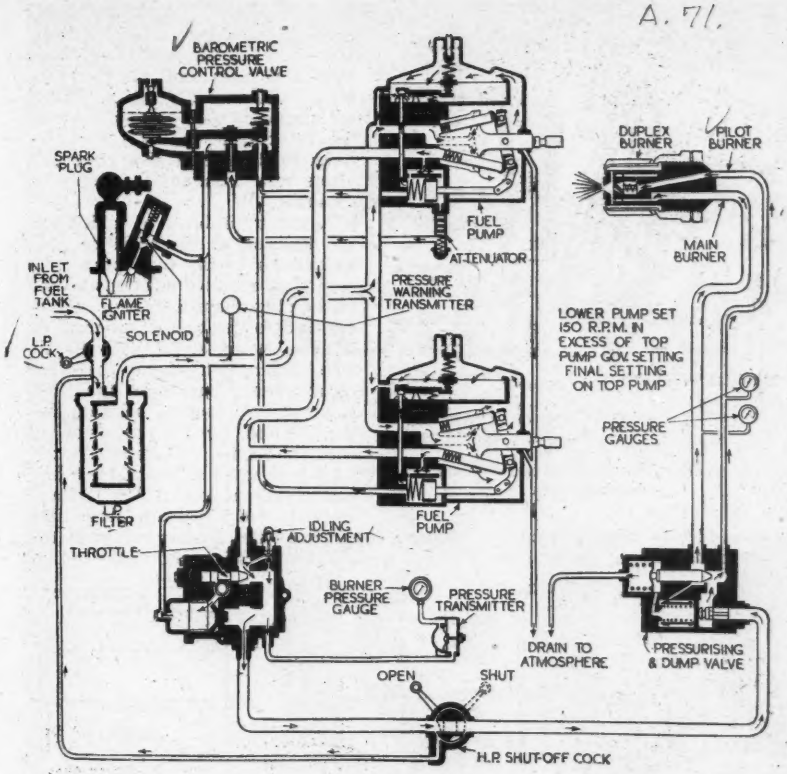


Diagrammatic layout of fuel system.

assembled the guide vanes are gauged at five diameters to check the intervening apertures and thus the total area of the inlet to the turbine.

Bolted up to the turbine shroud ring and nozzle box is the exhaust cone with its inner cone supported by four transverse bolts enclosed by streamlined fairings. The base of the inner cone masks the rear face of the turbine disc. While the exhaust cone is of fixed length, approximately 33in, the jet pipe extending from the exhaust cone to the propulsion nozzle can be varied to meet installation requirements provided a suitable length-diameter ratio is maintained. These parts are double-walled and packed with heat-insulating material. Standard length of jet pipe is about 44in and the weight is 9.5 lb per ft.

Combustion Chamber Design

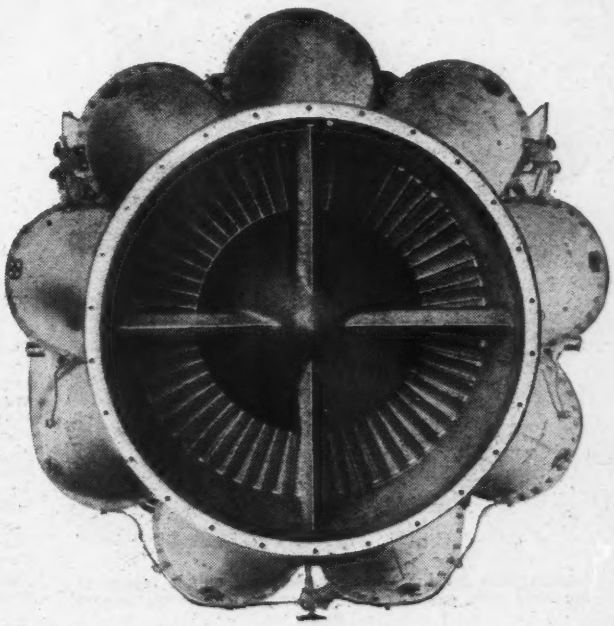
Combustion chambers are similar in general design to those of the Derwent V but of larger capacity. Outer casing and end cap are of mild steel but end caps will eventually be L.A. castings to facilitate production. As before, the perforated flame tube arranged concentrically with the outer casing is of Nimonic 75. The fuel is sprayed downstream, and through a metering orifice in the end of the flame tube a quantity of air is admitted to form the combustible mixture. This primary air has its velocity reduced by means of a "colander" and swirl vanes surrounding the burner to ensure flame stability. Secondary air flows along the annular space between flame tube and casing and is progressively fed through holes to the interior of the flame tube to dilute the mixture to a ratio of about 60: 1 and lower the gas temperature to about 875 deg C as it reaches the turbine nozzle. As the heat drop at the turbine is 175 deg C the temperature of the gases in the jet pipe is approximately 700 deg. C.

The layout and connections of the fuel system are shown diagrammatically in the adjoining sketch, and the location of many of the items of equipment may be seen on the view of the front end of the complete unit, page 390. Most of the components are of Lucas manufacture and are of the type used on the Rolls-Royce Derwent and fully described in *Flight*, January 10th, 1946. A Pulsometer booster pump submerged in the tank supplies fuel past the low-pressure cock to the Tecalemit filter, from which the two multiple - plunger, variable - stroke, pumps draw their supply.

Fuel System

The two pumps are arranged in parallel, and each has an incorporated hydraulic pressure control, but final setting is determined on the upper pump. Control of the pumps to maintain the requisite delivery at speed and altitude is effected automatically by the barometric pressure control unit. As it is mounted on the wheelcase on the front of the compressor casing it is inside the nacelle and consequently responsive to the ram effect at speed as well as altitude and local atmospheric conditions.

From the pumps the fuel is delivered to the pilot's throttle valve, a manually-operated variable orifice, and thence to the high-pressure cock, also manually operated by the pilot to cut the supply to the burners and so shut down the unit. On the throttle valve is an adjustable by-pass through which fuel flows to maintain the engine running at idling speed when only the throttle valve is closed. A pressurising valve is inserted between the high-pressure cock and the ring manifolds supplying the burners. This is merely a spring-loaded, conical-seating plunger which at low pressure and volume is closed to ensure that all fuel is delivered by way of the small-diameter pilot manifold.

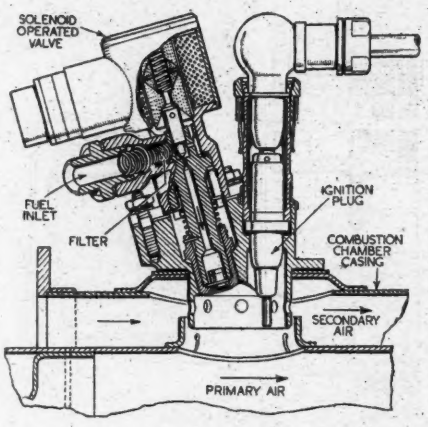


This view up the exhaust cone indicates the possibility of visual examination of the turbine blades after removal of the jet pipe.

ROLLS-ROYCE NENE I

As pressure builds up the valve is lifted against its spring to admit fuel to the larger diameter main manifold. Incorporated with this unit is the spring-loaded dump valve. In operation, even at idling speeds, the fuel pressure closes this valve, but when the high-pressure cock is shut off and pressure falls, it opens automatically to drain the manifolds.

The provision of duplex fuel burners is to ensure, without resort to abnormally high pressures, a completely atomized fuel spray at the low rates of flow occurring when cranking for a start and also under high-altitude conditions. Separate connections from the pilot and main manifolds are taken to each burner. Under reduced flow conditions all the fuel is delivered to the pilot atomizer. It passes through helical grooves cut in the face of a conical plug to reach the swirl chamber, and is projected as a finely atomized conical spray.



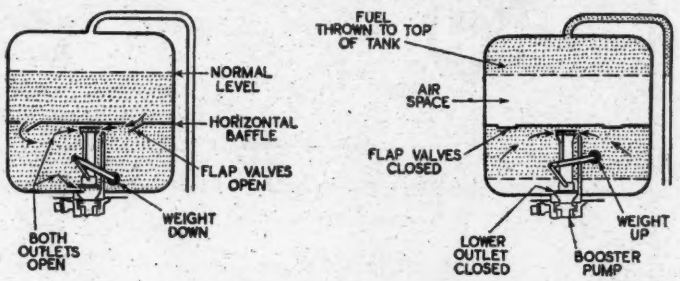
Flame igniters are fitted to two combustion chambers only.

Burner Operation

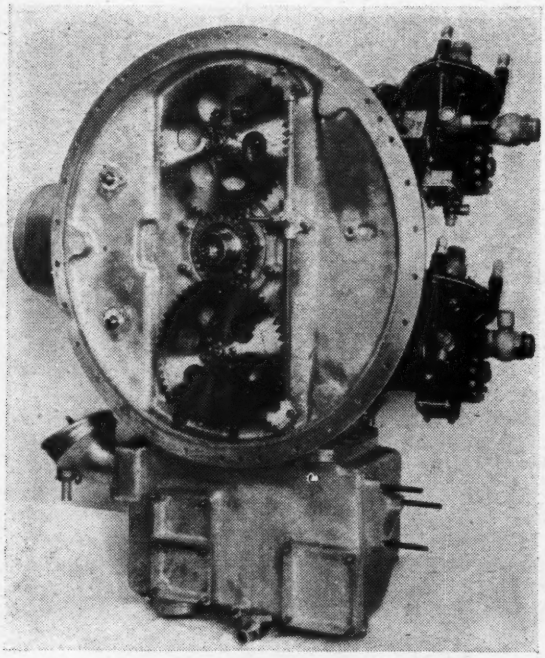
At the substantially higher rates of flow during normal operating conditions, the pressurizing valve is lifted and fuel is delivered to both the pilot and the main manifolds. The pilot flow continues as before, whilst fuel from the main manifold passes to an annular space surrounding the housing of the primary swirl cone. Through a series of holes in the ring element in which the primary swirl cone is seated the fuel reaches the swirl plate having a number of tangential slots communicating with the central swirl chamber. Here the primary and main flows mix and pass out of the final orifice. The functions of a particular burner may be readily adjusted by substituting a swirl plate of different thickness which, of course, alters the volume of the swirl chamber.

A minor problem of ignition is the location of the sparking plug in relation to the fuel spray. To secure an effective position the end of the plug was usually more or less exposed to the heat of combustion and liable to suffer accordingly. The larger diameter of the Nene combustion chambers intensified this problem, but a solution has been found by the provision of what is termed the flame igniter. This is a small self-contained unit embodying a special low-pressure atomizer and a sparking plug. Fuel at the low pressure supplied by the booster pump to the inlet side of the high-pressure pumps is piped to the igniter and controlled by a Messier solenoid-operated valve. Normally this valve is closed, but at appropriate timing in the starting cycle the solenoid is energized and fuel flows through the atomizer and is ignited by the sparking plug A flaming jet of fuel, as from a blow torch, is then projected into the main fuel spray from the burner. The ends of both atomizer and sparking plug are shrouded, and in any case are only exposed to the secondary air in the annular space between the flame tube and the outer casing of the combustion chamber. One igniter is sufficient for a complete engine unit, but two are fitted to cover all eventualities. From the two combustion chambers fitted with flame igniters combustion is propagated to other chambers through the usual connecting pipes. The igniters, of course, only function for a brief period when starting and during normal operation are completely cut off.

For military machines it is necessary to make arrange-



The inverted-flight valve in the fuel tank. (Left) normal conditions. (Right) " negative g " conditions.



Internal view of the wheelcase showing simple layout of auxiliary drive gears. Attached to the base is the 10-pint oil sump.

NENE I DATA

Diameter	49.5in.
Length, to turbine	63.9in.
Length, including exhaust cone	96.8in.
Weight, less jet pipe	1,550 lb.
Weight, jet pipe	9.5 lb. per ft.
Fuel—Aviation Kerosene + 1 per cent. lubricating oil	0.806 S.G.
Fuel consumption, sea-level static, 4,000 lb thrust	1.055 lb/lb/hr.
Fuel consumption, sea-level static, 5,000 lb thrust	1.065 lb/lb/hr.
Air consumption, 5,000 lb thrust	89 lb/sec.
Compression ratio	4 : 1 static
Maximum speed	12,300 r.p.m.
Maximum thrust	5,000 lb.
Compressor impeller, peripheral velocity	1,530 ft/sec.
Turbine rotor, mean blade speed	1,070 ft/sec.
Acceleration 2,500—12,300 r.p.m.	4.5 sec.

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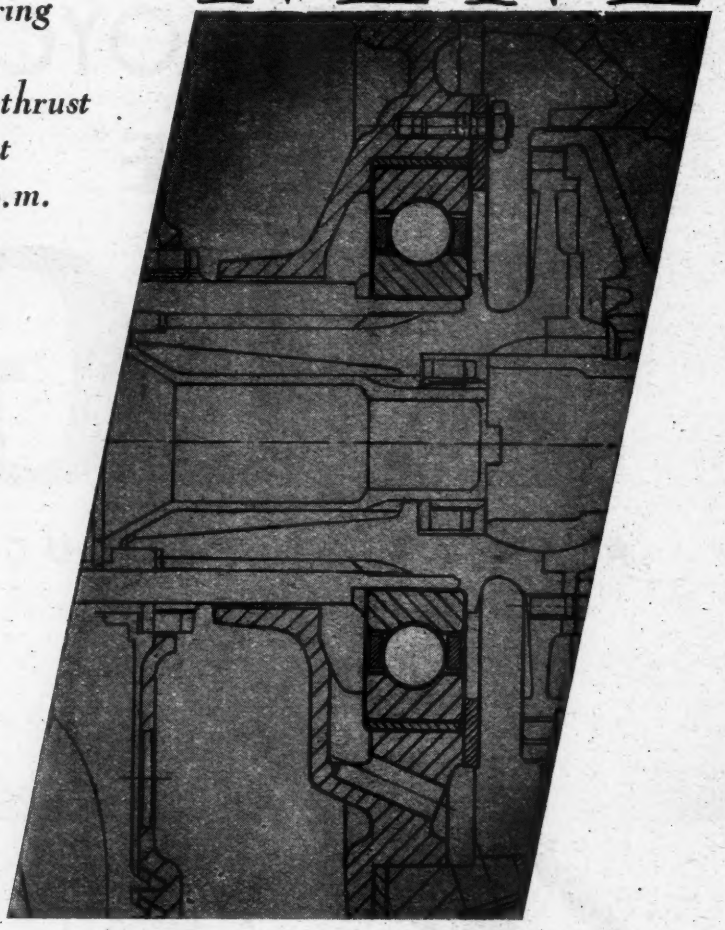
14

ON THE ROLLS-ROYCE

NENE

This bearing takes 5,000 lb. thrust and runs at 12,300 r.p.m. under high-temperature conditions



The three ball and parallel roller main shaft bearings are by

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Also fitted on the 'Derwent' and 'Merlin'

ROLLS-ROYCE NENE I

ments for exceptional conditions during aerobatics. Accordingly, the fuel tank is fitted with an inverted-flight valve to ensure an uninterrupted supply of fuel to the jet unit under conditions of "negative g." The sketch shows the flow under two different conditions. At about mid-height, the tank has a horizontal partition furnished with flap valves closing on the under side. The outlet tube has a lower orifice on the tank base and an upper orifice adjacent to the partition. Over the tube slides a sleeve actuated by a weight and linkage to control the lower orifice. In normal operation the sleeve is raised by the weight and fuel flows through the flap valves in the partition and through both upper and lower outlets to the booster pump. Under conditions of "negative g," when the fuel tends to surge to the top of the tank, the flap valves close and some portion of the fuel is trapped in the lower compartment. The weight rises, closes the lower orifice which is now exposed, and fuel continues to flow from the upper orifice below the partition.

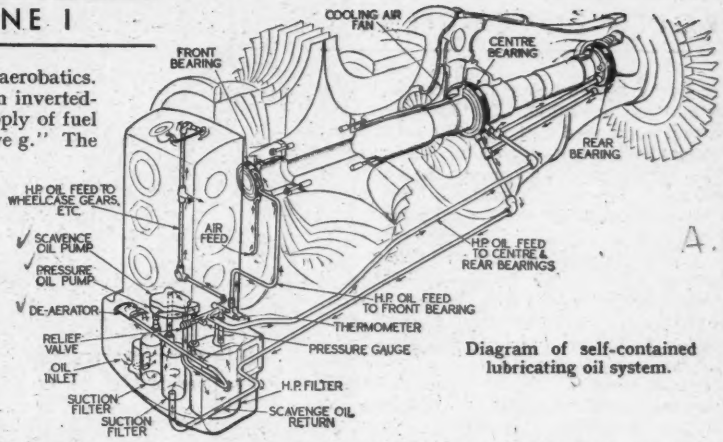
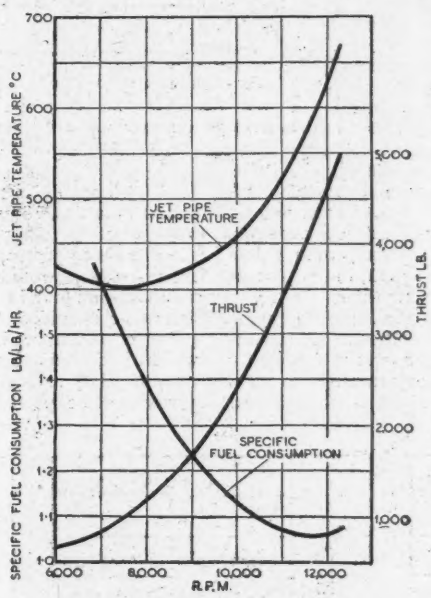


Diagram of self-contained lubricating oil system.

A.26

Lubrication

As there are only three main journal bearings and no sliding metal-to-metal surfaces the lubrication system of a turbine-jet unit, as compared with that of a reciprocating engine, is relatively simple. On the Nene a wet-sump system is employed, constituting a change from earlier Rolls-Royce practice. The Derwent had a dry sump and separate oil tank. In the sump in the base of the wheelcase are housed the gear-type pressure and scavenge pumps, a Purolator pressure filter, a pressure relief valve and a de-aerator. The pressure pump draws oil from the sump through a gauze strainer and delivers to the pressure filter. From here it is fed to the three bearings and a gallery pipe with metered jets for wheelcase bearings. Oil from the front bearing and the wheelcase drains back to the sump by gravity, but from centre and rear bearings it is drawn off by the scavenge pump through a gauze strainer and delivered to the de-aerator and, finally, to the sump. An interesting feature is the sealing of the front bearing by compressed air to prevent the possibility of oil leaking to the front of the compressor impeller. Oil consumption at any rating is less than one pint per hour. The sump will contain ten pints, but a minimum of eight pints is necessary to maintain circulation.

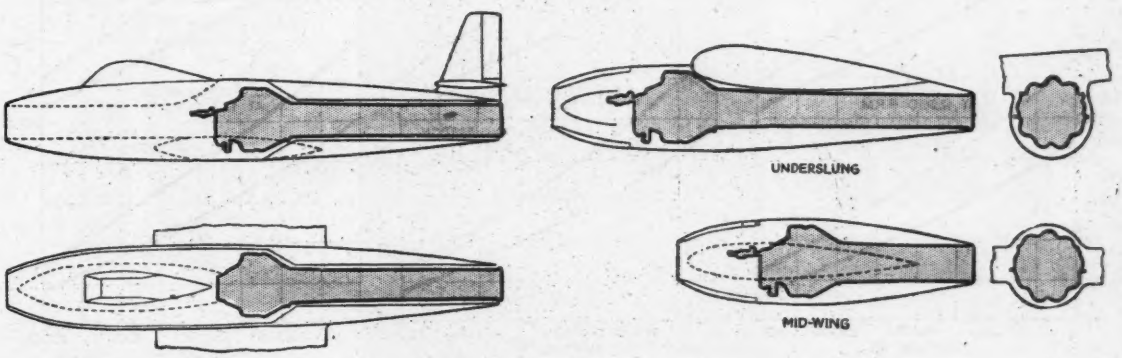


Performance on the test bed.

Conforming to current practice, aircraft accessory components are driven through a gear box mounted on the wheelcase. A choice of three drives, horizontal above or below the main shaft and inclined from the head of the wheelcase, is provided for a Rotol gear box weighing about 35½ lb. On this unit can be mounted and driven a hydraulic pump, electric generator, vacuum pump and air compressor as required for the installation. Gear box and accessories are all within the installation diameter about 49in required for the Nene. Cabin heating or gun warming can be arranged by means of air heating jackets around the jet pipe.

Starting Cycle

Starting is effected by a 24-volt electric motor and all necessary operations are effected by a timed automatic cycle. When the master switch is closed, current is supplied to the booster fuel pump and a warning light glows until the requisite pressure is built up. With the throttle closed, depression of



Typical single-unit fuselage and multi-unit wing nacelle installation diagrams.

ROLLS-ROYCE NENE I

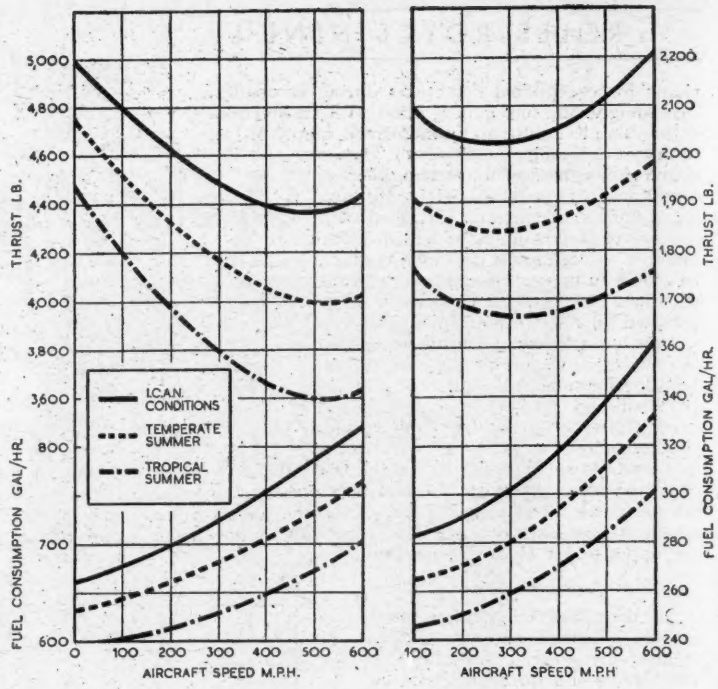
the starter button brings the clockwork time switch into operation. In timed sequence, current is supplied to the ignition coils, flame igniters and the starter motor. The motor takes up the drive and cranks the engine at low speed for about 5 seconds, after which a relay closes to allow full excitation of the motor. The time switch completes its cycle in 30 seconds and cuts off all current. If, however, the engine starts and reaches a predetermined speed prior to this, starter, ignition coils and flame igniters are automatically cut out.

Nene units at present in production are rated at 5,000 lb thrust. This is neither the maximum at present available nor the ultimate possibility. A thrust of 5,500 lb has already been obtained on the test bed. The average figure during development was 5,150 lb, which represents the following component efficiencies: Compressor, 76 per cent; combustion, 98 per cent; expansion, 93 per cent.

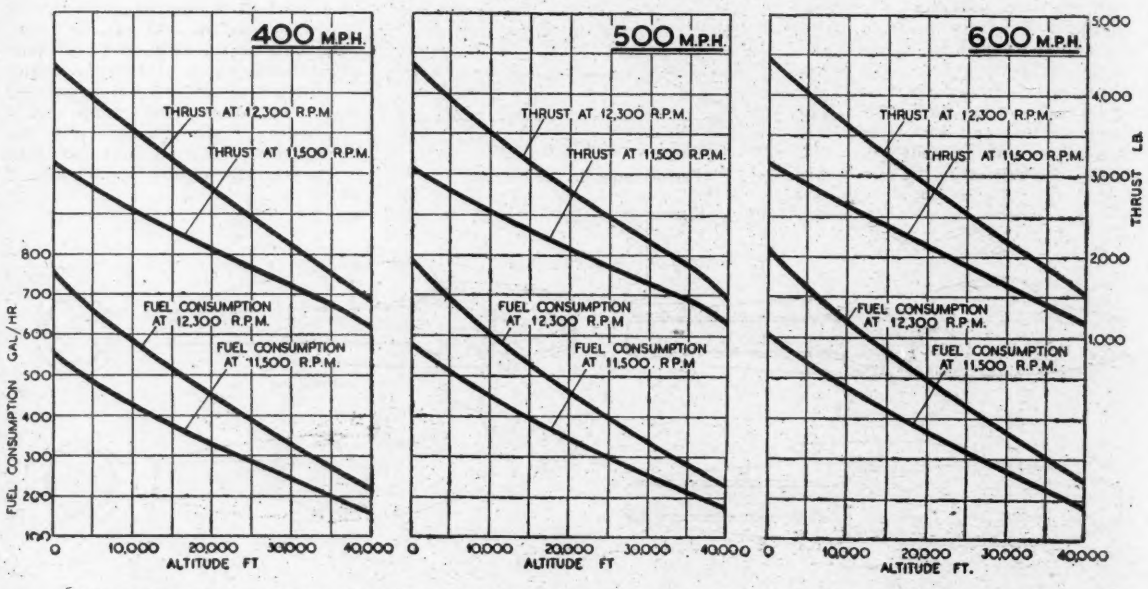
Design throughout has been with the aim of facilitating progressive development in the familiar Rolls-Royce tradition.

The first aircraft to be powered by the Nene was a Lockheed X-P80 Shooting Star, and recently tests have been conducted on a de Havilland Vampire. In both instances an improvement in performance was obtained. With the American aircraft speeds of the order of 580 m.p.h. and an excellent rate of climb to 42,000ft were achieved. However, new aircraft will be required to take full advantage of the thrust now available from the Nene. Several prototype aircraft, both single and twin-unit designs, are under construction, but at present no information can be released concerning them.

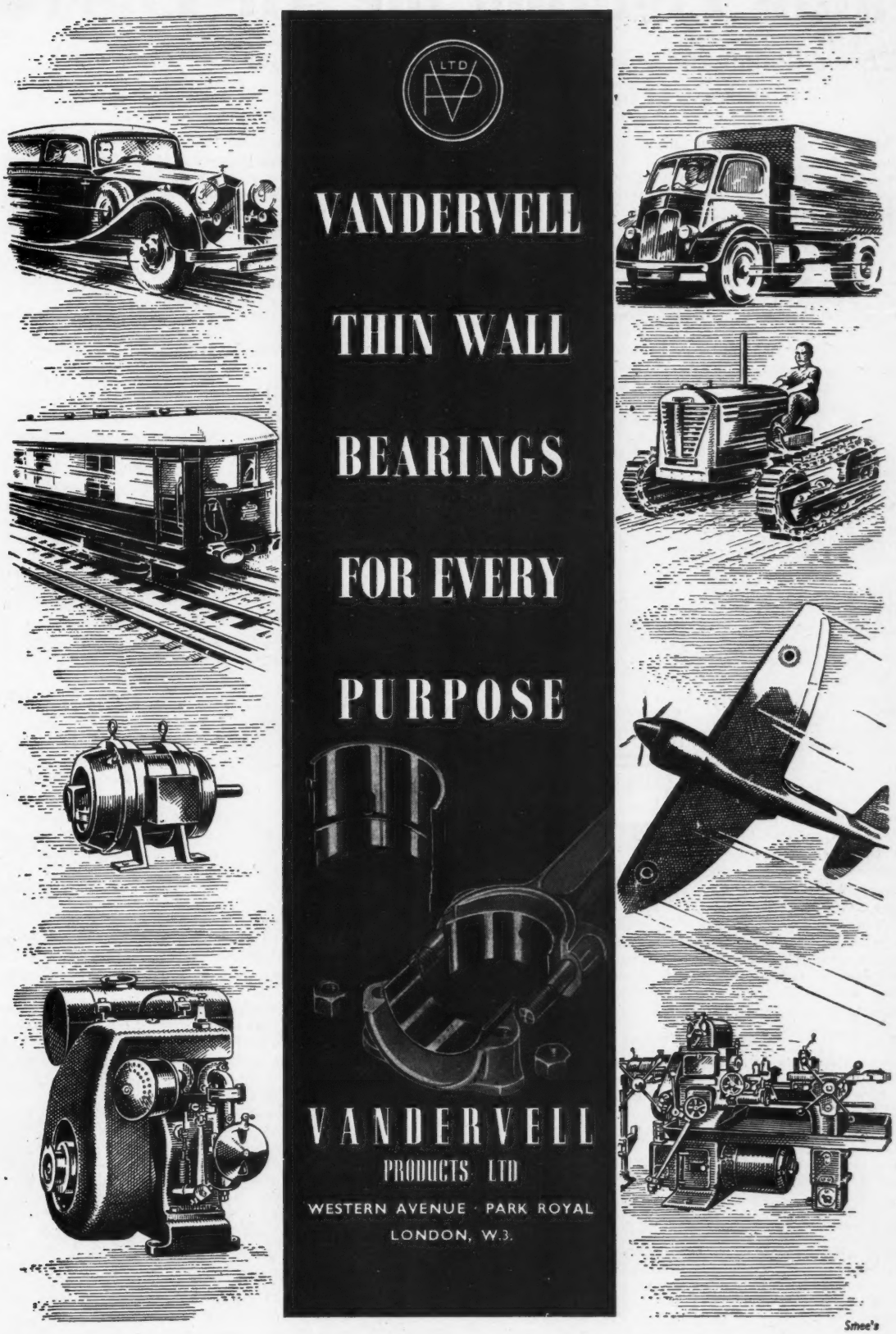
The high thrust and light weight of the Nene jet engine make it a potential competitor of the orthodox reciprocating engine for medium range heavy bombers. Recently Dr. S. G. Hooker gave estimated performance figures for a Lancaster powered with four Nene units. It was claimed that with an all-up weight of 60,000 lb the cruising speed would be about 400 m.p.h. at all altitudes up to 35,000ft. With existing fuel tanks, range would be approximately 1,000 miles at 30,000ft. As the installed weight of the four Nene engines would be only 8,000 lb as compared to 12,000 lb for four Merlins, tankage could be increased and the range extended. To obtain a 25 per cent increase in power accompanied by a 33 per cent reduction in installed weight is an indication of the importance of a change from reciprocating to rotating power units and a hint of the performance expected from specially designed aircraft.



Estimated performance under various atmospheric conditions. (Left) at sea level. (Right) at 30,000 feet.



Estimated performance at aircraft speeds of 400, 500 and 600 m.p.h. at altitudes ranging from sea-level to 40,000 ft.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Cabin Lighting for Air Liners

Even Illumination Required to Ensure Maximum Eye Comfort : Fluorescent System Advocated

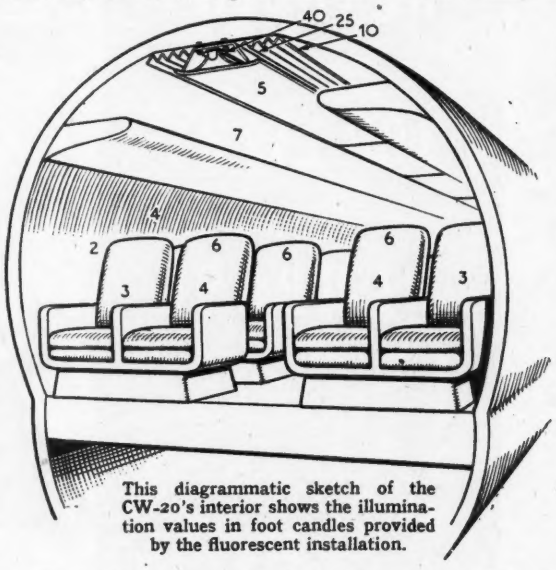
THERE is no doubt that airline passengers, however seasoned, experience a good deal of strain and fatigue as a result of height, the monotonous drone of engines, the restricted space, etc. Pressurising, air conditioning and well-planned lighting can all help to reduce this fatigue factor.

Strong arguments in favour of indirect fluorescent lighting for the cabins of airliners were put forward in a paper recently presented by Mr. R. A. Rugge, of the Curtiss-Wright Corporation, before the Society of Automotive Engineers in Chicago. The paper contained the results of experiments carried out in the cabin of a CW-20E (civil version of the Commando transport) to achieve certain conditions of illumination recommended for eye comfort.

Eye comfort depends chiefly on a uniform degree of brightness, particularly of adjacent areas; a lighting system should, therefore, avoid sharp contrasts, the desirable limit of variation being not more than 10 to 1.

It was not easy to apply this rule to aircraft cabin lighting as the low ceiling and corridor-like shape of the cabin meant that the source of light itself was part of the passenger's visual field; also there were weight restrictions to consider. One of the best compromise solutions was the conversion of four direct-lighting ceiling fixtures to indirect lighting by fitting a metal shield beneath them. This eliminated the glare of the lamps and their diffusing glasses, but fell short of the 10 to 1 limit in brightness variation throughout the cabin, the ceiling above the indirect source of light being much more brightly lit than the rest of the interior.

There was no need to fear early obsolescence due to rapid developments, if the system were planned so that the passenger could see easily the colour and detail of objects without eye discomfort. The basic requirements remained and these were the illumination of all objects in the field of vision for which a minimum of five foot-candles was recommended, and a soft white light that accentuated the colour and freshness of objects and fabrics.



This diagrammatic sketch of the CW-20's interior shows the illumination values in foot candles provided by the fluorescent installation.

Concealed Source

Because the main illumination source generally dominated the visual field in an aircraft cabin, the source of light should either be concealed by an indirect fixture, or be a direct fixture of low surface brightness. Reflecting surfaces adjacent to the source of light should also be of low surface brightness compared to that of other objects farther away from it. Illumination for passenger reading should be provided by special reading lights in combination with the general illumination. It is natural for the eyes to seek out the darkest corners in a room or enclosure, and if the ratio of light from surrounding areas is in too great contrast (greater than 10 to 1) the eyes tire from the continual shifting and refocusing between the dark and light areas. Minimum illumination for passenger reading should be 15 foot-candles.

The paper goes on to describe in considerable detail a number of lighting arrangements tried out before settling on the indirect fluorescent layout shown in the accompanying illustration. For example, indirect side fixtures were tried but proved unsatisfactory because of the high surface brightness reflections immediately above. Another system used four 21 c.p. incandescent lamps in a skylight type of indirect fixture in which the lamps were mounted in alcoves in the side of the recessed fixture. This gave a high level of illumination, but, again, there was too much contrast in brightness, this time between the fixture and the adjacent ceiling.

Even Distribution

Finally, the strip type indirect fixture was arrived at and tried with both incandescent and fluorescent lighting, and it was found that the former produced light striations and water-line patterns on the ceiling, while the fluorescent tubes gave an even light distribution free from those faults.

The basic design of the strip type installation illustrated consists of a line of fluorescent tubes covered by the strip reflector that directs light on to corrugated plastic panels fastened to the ceiling on each side of the fixture. These plastic panels have a sand-blasted diffusing surface and a painted upper surface for light reflection. The degree of sand-blasting was a matter for experimenting until satisfactory diffusion was obtained without high surface brightness, and the angle of the corrugations in the plastic panels was determined geometrically to direct some of the light downwards and some on to areas under the opposite luggage racks.

The type of fluorescent tube used was the F-15(T-8)SW. These are 18in. long and were spaced 2½in. apart (end to end) for ease of installation and to conform with the 20.5in. spacing of the fuselage rings. The slight shadow effect thus caused was hardly noticeable on the lighted cabin ceiling. A final modification was to change the under surface of the strip fixture from the dark blue-grey first selected to a light cream colour, so reducing the difference in illumination value between it and the adjacent surfaces.

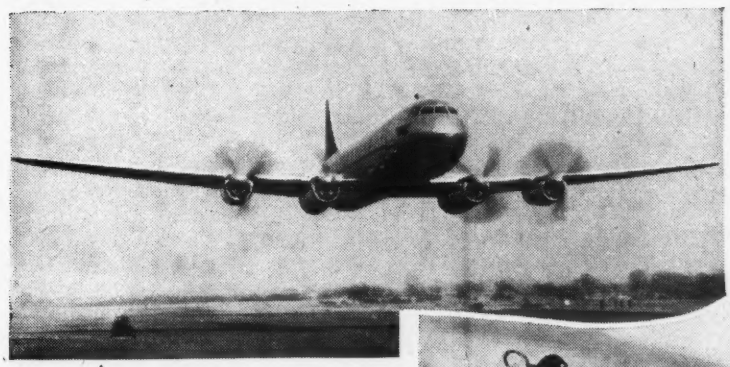
With this system something approaching the ideal has been attained, for only the inner corrugations of the plastic panels immediately above the source of light, and the wall area below the luggage racks exceed the 10 to 1 variation limit; everything else comes well within this limit.

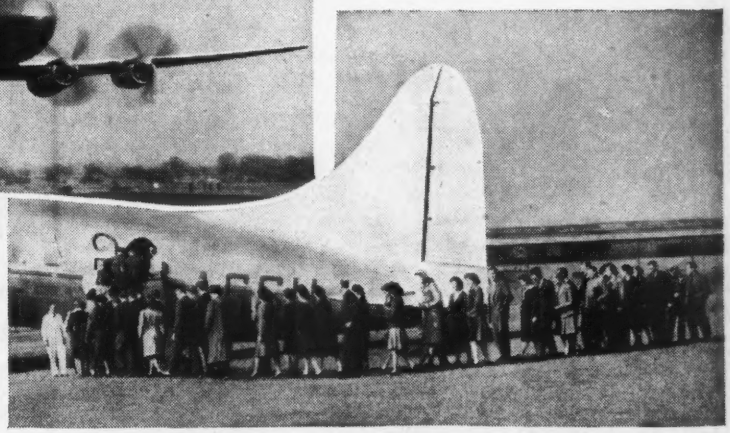
The paper includes a detailed analysis of comparative weights, costs, power consumption, etc., as between incandescent and fluorescent equipment, but the main points may be summarized as follows.

The only factors in which the incandescent equipment seems to have advantage is in weight and initial cost. As applied to the cabin of the CW-20E, the fluorescent system proved to be 3.24lb. heavier than the incandescent, an increase of 20 per cent. A comparison of power consumption showed a 65 per cent. advantage to fluorescent tubes, and although the initial cost of fluorescent tubes is almost double that of incandescent lamps, the burning life of the former under aircraft vibration conditions is at least five times greater. Tests carried out by the lamp manufacturers and the Curtiss-Wright laboratory showed replacement costs to be only 3.3 cents per 100 hr. for fluorescent tubes as against 14 cents for incandescent lamps.

TUDOR II IN CAMERA

Round Avro's New Sixty Seater with "Flight's" Cameraman

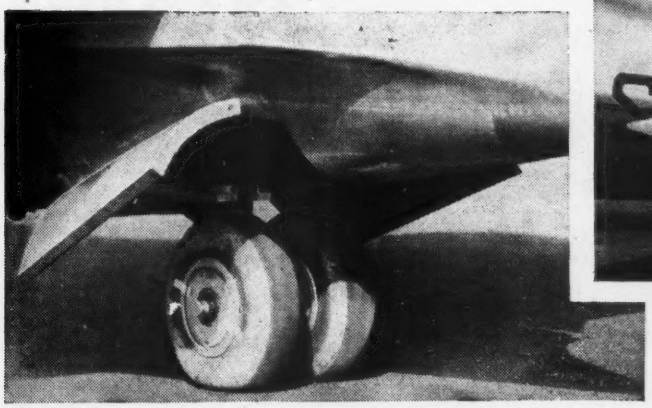




Leaving the runway at Woodford the first of the Tudor IIs takes off for a demonstration of its capabilities. Right: A queue of passengers going aboard to make up the full load of sixty. An alternative accommodation scheme caters for forty day passengers or twenty night sleepers.

Scale is given to the Tudor's size by the figure beneath the wing. The blending of fuselage and wing undersurface, and the neatness of the undercarriage are noteworthy features.

Sir R. H. Dobson confers with "Bill" Thorn and Jimmy Orrel, Avro test pilots, after a flight. In the foreground are the Avro production and experimental chiefs, C. E. Fielding and Mr. Sewart.



(Above) The massive fin and rudder which sweep so admirably into the tail cone are to be superseded in production machines by units of even greater area. (Left) The twin tailwheels are carried on a special strut in which both retraction jack and liquid-spring shock absorber are incorporated.

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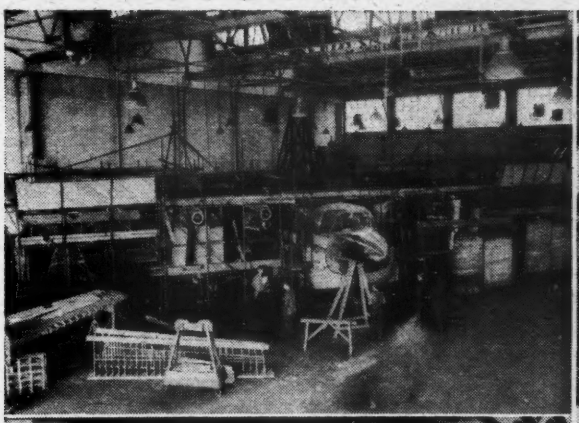
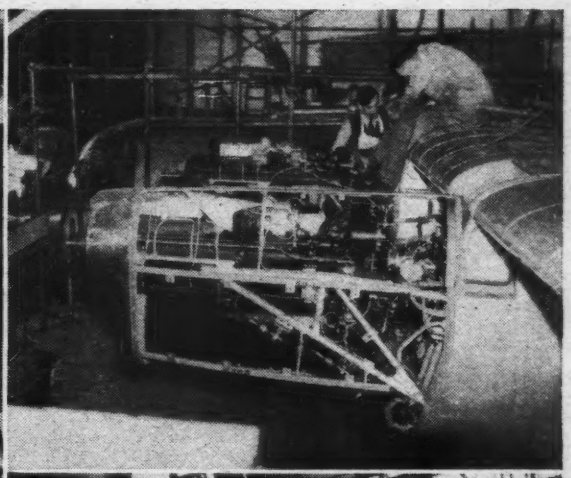
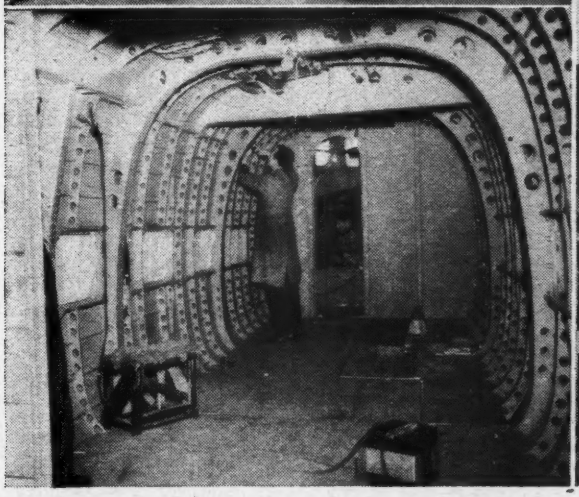
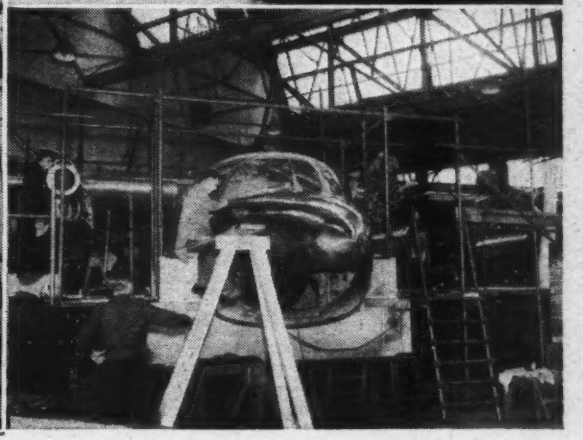
A Brabazon Comes to Life









A BRABAZON COMES TO LIFE: Four photographs which show how the work on the prototype of one of the Brabazon series of civil aircraft is proceeding. This is the Miles Marathon, which has been given the cryptic number 5a in a list of numbers which is still incomplete as far as the general public is concerned. The Marathon, which should be flying this summer, will have a maximum range of 1,000 miles while carrying thirteen passengers, and will, we are told, be lightly "pressurized"—at least as far as the passenger compartment is concerned. No "full" pressurization is likely to be possible with a fuselage of such comfortable shape. The engines are to be Gipsy Queen 71s and the maximum cruising speed 210 m.p.h. A full complement of eighteen passengers will be carried over comparatively short ranges.

STAFF CHANGES

ELECTRO-HYDRAULICS (MESSIER), LTD., formerly Messier Aircraft Equipment, Ltd., announce that the following staff changes have been made in the organization of their technical department: Chief Designer, Mr. C. B. V. Neilson; Chief Undercarriage Designer, Mr. H. Davies; Chief Draughtsman, Mr. H. B. Caldwell; Hydraulics Engineer, Mr. G. Orloff; Assistant Hydraulics Engineer, Mr. K. G. Hancock; Electrical Engineer, Mr. A. Hunter; Chief Stressman, Mr. R. G. Hoare.

A MAHARAJAH TRAVELS

HIS HIGHNESS THE GAEKWAR OF BARODA, the well-known racehorse owner whose newly acquired headquarters are at Newmarket, has flown to Britain from India in his own aircraft.

Unable to arrange speedy transport otherwise for himself and members of his family and staff, the Maharajah bought a Halton transport. It is the civil version of the Handley Page Halifax C.VIII military transport. A number of these aircraft will be operated shortly by B.O.A.C.

The Halton was flown to India and back by Sqn. Ldr. E. A. Hood and a specially chosen crew of British American Air Services, Ltd. Total time in the air for the round trip to Bombay was 56½ hours. Calls were made at Malta, Cairo, Baghdad, Karachi. Similar stops were made on the return trip, except that the Halton put down at Basra instead of at Baghdad. This gave 10,749 air miles for the return trip at an average speed of slightly more than 190 m.p.h. and a fuel consumption of 1.01 m.p.g. Total loading averaged 61,000lb.

ROCKY MOUNTAIN SECRET

AN experiment in the construction of floating ice airfields for anti-submarine work was conducted during the war in the Canadian Rockies at Lake Patricia in Jasper National Park. Operation "Habakkuk," as it was known, was carried out in secrecy.

A structure 60ft long containing iceblocks with pipes woven through them to a refrigeration plant gave them a teasing problem. One day the ice was sawn through and "Habakkuk" became a floating island. Thus the test was made for a series of ice airfields to float in mid-Atlantic.

Many scientists, including Professor A. Bernall from Combined Operations headquarters, visited this strange project and much technical information was gained in the handling of ice.

MONACO ENGINE RUNS

THE new Monaco 100 h.p. flat-four light aircraft engine, which was announced in the March 14th issue of *Flight*, has just successfully completed its maiden run. Further developments with this power unit may be expected shortly.

Britain's Test Pilots

No. 5
GEOFFREY DE HAVILLAND, O.B.E.

(Left) A characteristic photograph of Geoffrey de Havilland in the cockpit of the jet propelled Vampire. (Below) With his father after a flight in one of the early Moths about 20 years ago.

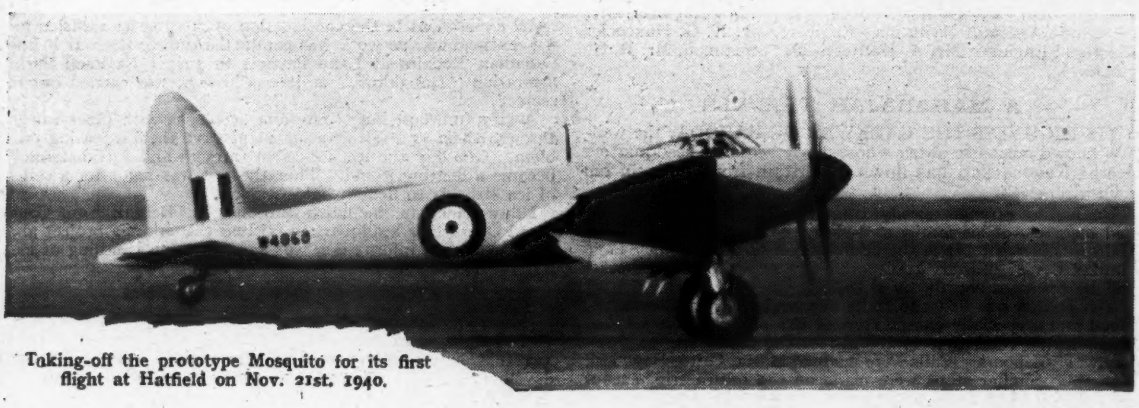
AS a test pilot young D.H., as he is universally called, has not an exceptionally long history. He took over the chief test pilot's position in October, 1937, when R. J. Waight unfortunately lost his life on the T.K.4. Being, however, the son of his illustrious father, Sir Geoffrey de Havilland, who designed, built and test-flew his own aircraft from 1911 onwards, young Geoffrey can be said to have been "in the industry" from the very cradle. It is not generally known that Sir Geoffrey took his R.Ae.C. ticket No. 53 in February, 1911, on the second machine of his own design and construction, and that he has made many of the first flights on new D.H. types right up to the Moth Minor in 1938.

Geoffrey's first flight is lost in the dim past, but certain it is that at the tender age of six he was flying with father at Hendon in a D.H. 6 (also known as the Clutching Hand). When 18 years of age he left school and came to de Havillands as a premium apprentice for 4 years and learnt to fly on Moths at the firm's reserve training school. After spending two years in the drawing office—much of the time being spent looking out of the windows envying the pilots—he joined the Air Operating Company, who were doing a lot of air survey work in South Africa. This, however, gave him but very little flying, and at the end of six months, he came back to England to become a flying instructor to the D.H. Technical School. The aircraft were wooden Moths built by the students. In 1929 he took his B licence; a very simple business in those days. Some 20 or 30 hours' solo flying, a little cross-country work, a simple "Met" exam, and about one hour's night flying at Croydon was sufficient to qualify.

In 1934 Capt. Hubert Broad was chief test pilot of de Havillands, and Bob Waight looked after the production side. There was so much work, however, that Geoffrey was given the opportunity to lend a hand testing Tiger Moths, Dragons, Rapides, Express Air Liners, and Hornet Moths.

Broad left the company in 1935 and Waight took over, starting with the Dragonfly and later the Albatross. It was during the period when the prototype Albatross was going through its development flying that Waight lost his life, and de Havilland took over as chief test pilot. Nobody could have taken on a more interesting or more complex job because the Albatross was completely experimental from tip to tail. Engines were new, construction was new, and the layout was extremely advanced.

He had a curious experience on the Albatross. While



Taking-off the prototype Mosquito for its first flight at Hatfield on Nov. 21st. 1940.

The very experimental D.H. Albatross which was one of the types on which Geoffrey de Havilland did most of the development flying. It had some of the earliest close-cowled aircooled engines.

its strength was ample for all flying loads, some unfortunate drilling had weakened the fuselage under ground loads, and shortly after landing from a test flight the machine broke in halves on the ground.

When war broke out he was busy testing Oxfords and Flamingoes, but when things became desperate at the time of the Battle of Britain, de Havillands did a big job doing emergency repairs to shot-up Hurricanes.

Dick Reynell of Hawkers came over and gave Geoffrey the "know how" on Hurricanes. A little later Dick went out on operations with his old squadron (No. 43) and was, unfortunately, shot down. He was an excellent test pilot and a gallant gentleman.

Improvised Runway

Geoffrey flew the first Mosquito at Hatfield on November 21st, 1940, but he is more proud of the first flight of the prototype Mosquito fighter. This was built at a dispersal factory with no airfield. To save some six week's wasted time in transport and re-erection at Hatfield, Geoffrey used local fields by having bridges built over ditches to give him a 450yd run for take-off, and then flew the fighter to Hatfield.

He is, of course, one of the only two men in Britain to have made first flights on jet-propelled aircraft. The Vampire was flown for the first time on September 21st, 1943, but Geoffrey had already flown the Gloster E.28 at Farnborough.

The first airing of the Vampire proved it to be a tribute to the D.H. design and aerodynamics staff, as it behaved almost exactly as they had forecast. There was, however, somewhat of an aileron overbalance which limited the speed to 250 m.p.h. and a rather severe tip stall.

Geoffrey de Havilland had made a number of investigation flights on Mosquitoes for compressibility effects, but on the Vampire he has done extensive work. The Vampire, under the effects of compressibility, executes a series of sudden high-speed stalls. The path of the machine is similar to an artist's conception of a streak of lightning, and unless the pilot is strapped-in tightly he is likely to be knocked out by hitting the cockpit roof.

Geoffrey, with another pilot, has flown the Vampire in tight formation at over 500 m.p.h., and to investigate snaking, which is causing considerable trouble on most jet aircraft, he has flown the Vampire with rudder locked.

Like most of the test pilots, he is living on borrowed time, they having at some stage of their careers had close shaves. Strangely enough, Geoffrey's nearest go was on about the mildest type he ever flew. It was the first production Moth Minor. The prototype had completed its spinning tests, and the same tests on the production model appeared to be only a matter of form. He was flying with John Cunningham (now Group Capt., D.S.O., D.F.C., and test pilot for the D.H. engine division) at the time. The Minor was put into a spin at 5-6,000ft, but after it had failed to come out in five turns and the engine had stopped, a panic decision was made to abandon ship.

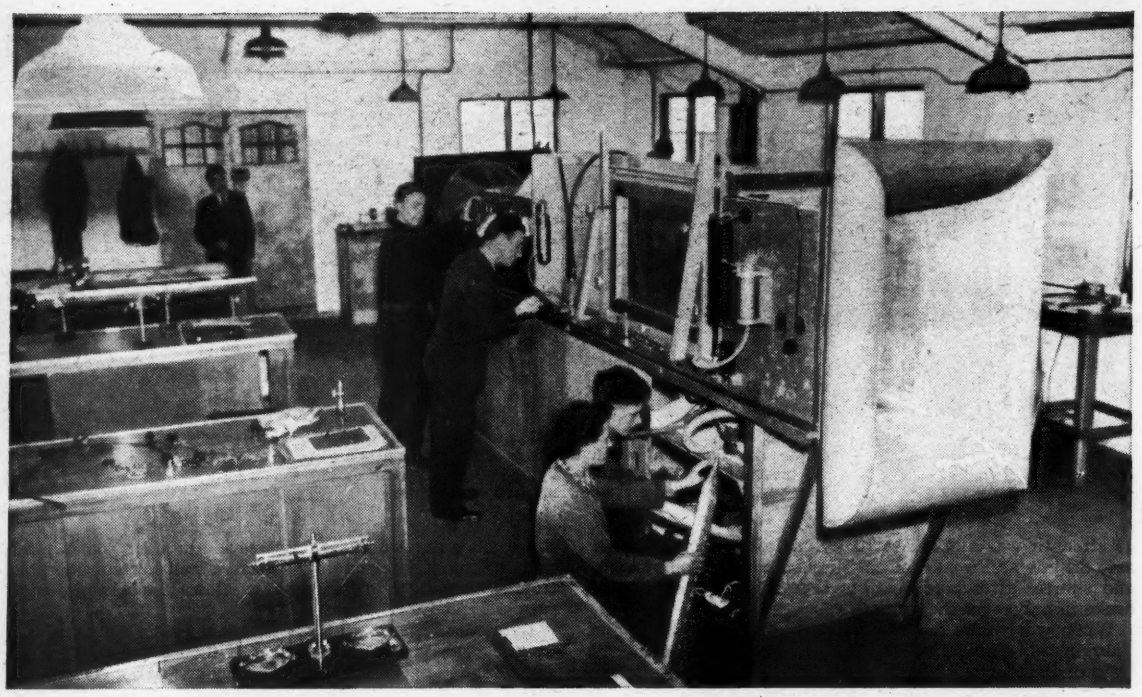
Test-flying a Hurricane, too, almost saw him off. This particular aircraft had had a gruelling time in the Battle of Britain, and the whole canopy came off at 4,000ft. hitting him in the face as it blew backwards. At first blind through the amount of blood in his eyes, he flew more by instinct than anything else until he found he could get a little relief by holding his face close to the instrument board. The blood dispersed a little and he was able to land through what appeared to be a thick yellow haze. He wears the scars across his nose to this day, and there was a terrible moment during that flight when he thought he was really blind.

Checking slight alterations to the Vampire's ailerons before another test flight.

On another occasion the oxygen bottle contained only compressed air, and the effects from this were at first blamed on the previous night's party.

At the other end of the scale was the test of the T.K.5, a tail-first aircraft built by the technical school. Impecunious at the time, Geoffrey had already mortgaged the bonus for the first flight. Imagine his consternation then when, after roaring the whole length of Hatfield airfield, the machine showed no sign of lifting. The forward elevator was ineffective. The T.K.5 never did fly and was finally abandoned.

In the days of peace before the war Geoffrey de Havilland was to be seen at all the air meetings and twice finished 4th in the King's Cup Race flying the TK1 and TK2.



This smoke tunnel twenty feet long and seven feet high for studying airflow characteristics has been designed by students of the school, who are also building it. The construction is now almost complete.

Miles Technical School

Private Scheme for Training Young Students : Complete Factory Practice in Classrooms

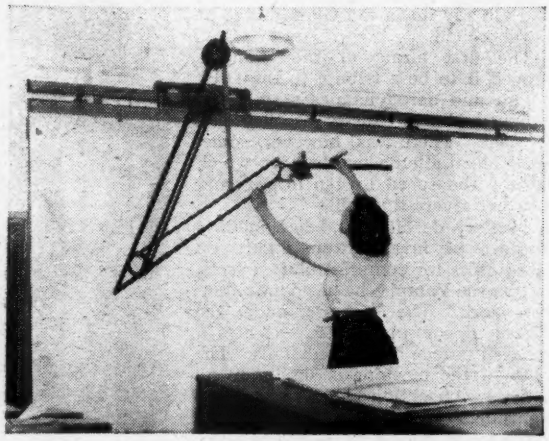
A NEW aircraft is being built at a factory belonging to Miles Aircraft, Ltd. Both the aircraft and the factory, however, are unusual, for the factory is part of a school and the new aircraft, except for its engines, is being constructed entirely by the students of the school without any aid other than consultation with their instructors. These students, whose ages are mostly between sixteen and nineteen, also designed the aircraft, and are carrying out all the detailed drawings and stresswork.

Some time ago, Mr. F. G. Miles, the managing director of the company, conceived the project of running this technical school in order to ensure sound practical, as well as theoretical training in aircraft engineering for junior employees. With the collaboration of Dr. Csato, and under the directorship of Mrs. F. G. Miles, who has had much to do with its success, the school was opened in 1943. Some 24 girls and 30 boys made up the first course. The system of training thus begun has steadily expanded until at the present time there are now over 100 students, and there is the prospect of further expansion in the future to a maximum of about 180 students.

A year or two before the school was opened, a small training centre had been started for junior draughtswomen with the approval of M.A.P. who had supplied the necessary hut accommodation. Fresh building being out of the question in wartime, these huts were moved to a new site alongside some disused farm buildings and the latter were converted to machine, fitting and assembly shops. Thus there was an excellent nucleus of buildings for a school for the new technical training scheme.

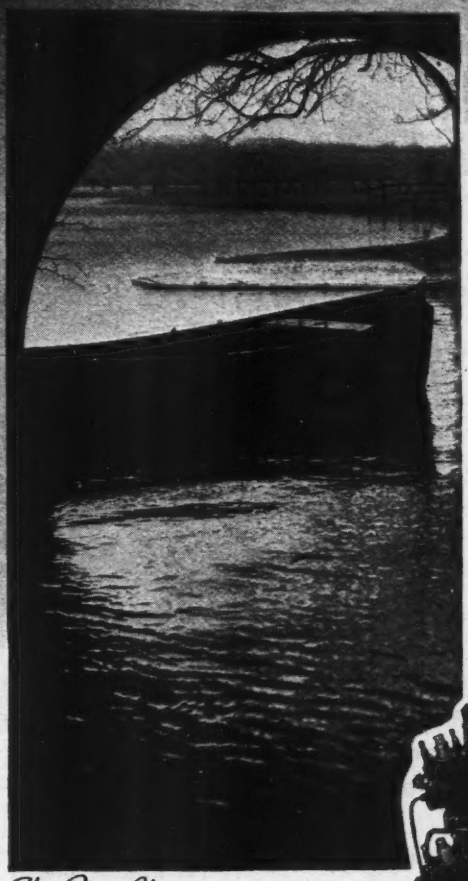
The scheme itself aims at giving not only adequate practical and theoretical experience to the trainee, but at giving also as much responsibility as possible in order that character and initiative are given every chance to develop. To this end, the students carry on with the minimum of supervision, and in fact their practical training savours more of normal "work" than of student exercises.

Entry to the school is by careful selection after personal interview. The chief qualifications demanded are that the prospective student should show intelligence and be of the right age and type. It does not matter whether his education has reached secondary or only elementary school standards provided that the standard of knowledge



One of the students at work with a parallel-action draughting machine on drawings of the school's aircraft. Much of the detail designing has been carried out by girl students.

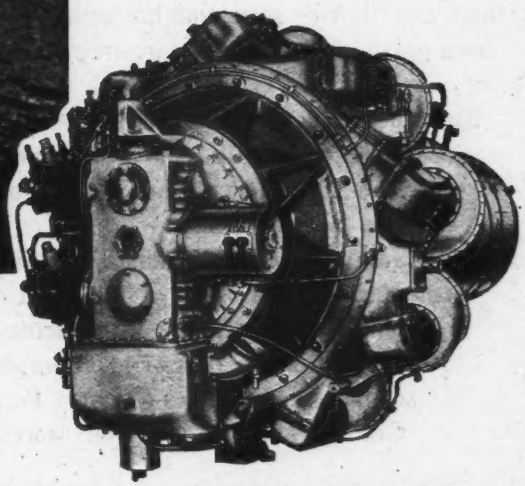
The River Class —



The River Nene

The Nene

The Nene jet propulsion engine, latest of the already famous Rolls-Royce River Class, develops over 5000 lbs. thrust and is the most powerful jet propulsion engine in production in the world.



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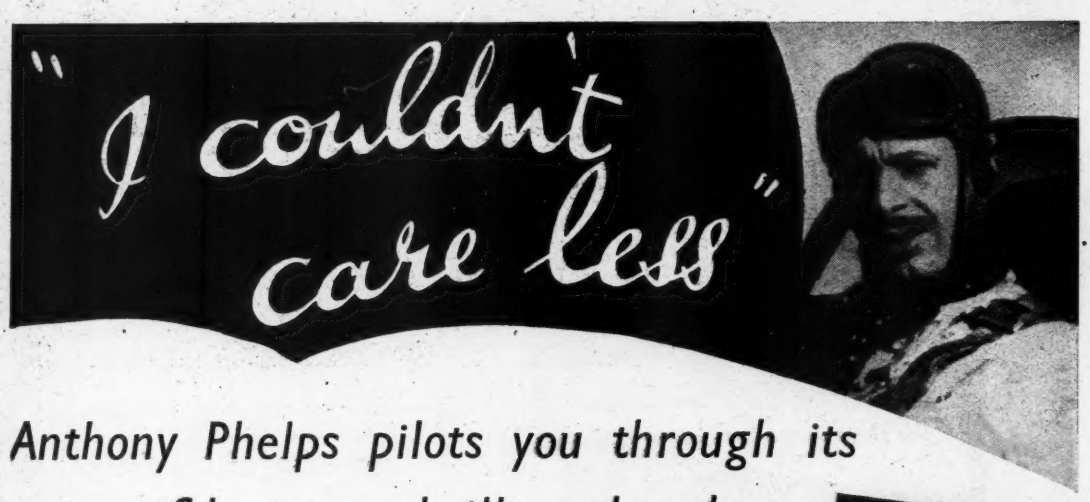

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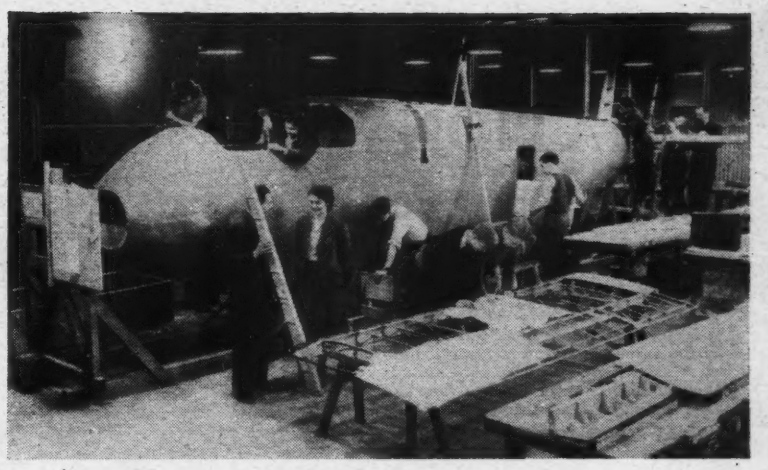
MILES TECHNICAL SCHOOL

attained is as adequate as that educational standard allows. In this way, discrimination on account of educational standards is avoided.

During the first year, training is given in the workshops and laboratory in such subjects as drawing, physics, woodwork, fitting, machining and engines, and in the lecture room the student receives instruction in a variety of subjects including physics, mathematics, electronics, hydraulics and theory of flight. Theoretical education amounts to some eight or ten lectures per week on mathematics and engineering subjects, but in addition to this technical training, general training is given and there are lectures on social and political subjects for which outside lecturers are introduced.

If at the end of the first year it is clear that any individual student is unlikely to gain by further instruction in the school, then he is afforded an opportunity to transfer to the Miles factory as an apprentice in some trade. The satisfactory student continues with more advanced training. Normally at the end of two years draughtsmen and draughtswomen are found to be sufficiently trained to transfer to the drawing office.



Designed and built entirely by the students to Mr F. G. Miles's specification, this aircraft is known as *Venture* and is to be used as a flying "test-bed." In the foreground Mrs. F. G. Miles, who directs the school, is seen talking to one of the instructors.

Student Administration

Other students continue until three years or even longer have been completed, by which time, the better students have reached the A.M.I.Mech.E. standard. Thus, no hard and fast rule is laid down about the length of training and full scope is given to the individual to make the best of his capabilities. Incidentally, in addition to regular students, very young employees of the Miles aircraft factory of ages 14 to 16 attend at the school for two half-days each week for further education.

The school, and the school factory which is attached to it, are entirely self-contained and the training principles adopted have been steadily developed until now, not only do the students carry out the work, but, acting as foremen, charge hands, chief draughtsman and section leaders, they supervise the shops and drawing offices in their school and factory. They maintain their own records and amend their own instruction books. They have also formed their own "joint production committee" to supervise the work of the school factory, and, similarly, an all-student committee runs the social and educational side of the school.

In August, 1943, Mr. F. G. Miles asked the school to design and build an aircraft which could be used as a "test-bed" for an electrical automatic pilot and for other electrical equipment. A high-wing twin-engined monoplane was specified, with a tricycle undercarriage and low landing speed, and the aircraft was required to carry two pilots with additional cabin space for engineers to work at a test bench. At the time, the only students with any drawing training were girls, and twelve of them submitted general designs. The best of these designs were used as a basis for further design work. A competition to find a name for the aircraft resulted in it being aptly called *Venture*.

It is a tribute to the form of training which is carried on at the school that the students seem to have encountered no insurmountable difficulty in tackling so ambitious a project. The main spar, forty feet long, was set up and constructed from ply and spruce by four students unaided. Two girls, sixteen and seventeen years old respectively, with less than six months' experience, laid out and completed the line drawings of the monocoque fuselage to full size and, as can be seen from the accompanying photograph, great progress has been made. All components incidentally, are A.I.D. tested and stamped. Already a second aircraft—a high-performance sailplane, is on the students' drawing boards, and boats and canoes have been built by them as a sideline.

A few of the students live near their school, but a very large proportion come to the school from long distances and are accommodated locally in three hostels. Although the leisure of these living-in students may be described as supervised in the sense that they have to book in and out and explain to some degree their comings and goings, there is, nevertheless, no attempt to curb their freedom unnecessarily.

Incidentally, no fees are charged for the training given at the school. In fact, the opposite is the case, for after the first term, during which the student must maintain himself, a system of scholarships comes into effect and, in the aggregate, these can provide each student with as much as £35 per term for good work and conduct. The basis is as follows: £10 for theoretical work, £10 for practical work, £10 for behaviour and £5 for Leadership.

The Headmaster, Mr. W. W. Evans, has now been in charge of the school for three years, and he obviously takes great pains to encourage any form of initiative shown by the students. Under him he has ten instructors, of whom three are graduates of engineering or mathematics. Of the remainder, five originally held technical positions of responsibility in the Miles Aircraft factory, and the other two are ex-R.A.F. engineer officers who were "Halton" trained. With such a team and with the constant encouragement given by Mrs. Miles it is hardly surprising that the school is an outstanding success.

FORTHCOMING EVENTS

April 25th.—R.AeS., Manchester Branch. (Whittle Lecture).
April 25th.—*R.Ae.S., "Modern Aeronautical Materials," by Dr. L. Aitcheson.
April 26th.—Institute of Transport. Lunch and address by Lord Winster. Connaught Rooms. 12.45 p.m.
April 27th.—S.L.A.E. Helicopter Lecture and Film: Manson House, Portland Place, W.1. Speaker: Mr. Raoul Hafner. 3.30 p.m.
May 2nd.—**R.AeS. Graduates' and Students' Section: "Transport Aircraft," by F. Radcliffe.
May 5th.—S.M.A.E., Midland Competition (petrol models) for the Sir John Shelley Cup.

* Lecture Hall, Institute of Civil Engineers, Gt. George St., S.W.
** The Library, 4 Hamilton Place, W.1.

CIVIL AVIATION NEWS

SHOT-WELDED FREIGHTER : Very little has been heard of the Budd Conestoga stainless steel freighter, but some of these are now in service with a cargo-carrying concern and manned by ex-Burma U.S. aircrew.

ORDERS FOR THE CONVAIR

IT is reported that American Airlines have ordered no fewer than a hundred Consolidated Vultee 240 aircraft for use on their shorter service. The 240 is a twin-engined, 40-passenger aircraft employing exhaust thrust as an auxiliary. Its estimated cruising speed is 300 m.p.h. and it has a number of interesting features from the passengers' point of view.

K.L.M. AFFAIRS

K.L.M. are to use Prestwick as an intermediate station on their north Atlantic services between Amsterdam, New York and Curacao as from May 21. In addition the company has applied to the Ministry of Civil Aviation for permission to operate regular services between Amsterdam and Prestwick beginning provisionally on May 1. The necessary ground services at Prestwick will be supplied by Scottish Aviation, Ltd., and Mr. J. L. de Jongh has been appointed manager of the local organization which is to be set up at the airport to represent K.L.M.

Incidentally, as from April 29, all internal Dutch air services will be taken over from the Dutch Government by K.L.M., and priority regulations for passengers will no longer apply.

TWO TYPES OF CONTROLLER

ANOTHER example of the confliction of terms in common usage in aviation circles was brought to our attention a few days ago. In the article "By Air to the Isles" in the issue of *Flight* for April 4, Mr. K. Stuart Smith was mentioned in an inscription as the Guernsey controller. As might be seen from the picture to which the inscription referred, the reference was to air traffic control. It should be explained, however, that at both Jersey and Guernsey airports, the airport manager is known as the airport controller, and, in case any readers should have been misled by the inscription, we would like to assure them that Mr. F. A. Swoffer is still Airport Controller at Guernsey.

If the nationalization of Civil Aviation and the inauguration of such international bodies as P.I.C.A.O. can bring about finally a standardization of terms as well as practices, a great benefit will have been bestowed on civil aviation generally.

NORWEGIAN AIR LINES

THE first post-war civil airline flight between Norway and England took place on April 8, when a Dakota of Det Norske Luftfartselskap A/S (Norwegian Airlines) arrived at Croydon from Oslo. In the evening, the directors of British European Airways entertained representatives of D.N.L. and the Norwegian Press at a dinner at the Dorchester Hotel. Col. Johan Christie, D.N.L.'s Director of Operations, presented one of the Norwegian airline's flags to Sir Harold Hartley, the Chairman-designate of B.E.A.

Daily services are now being run by D.N.L. between Oslo, Stavanger and Croydon, and also between Oslo, Gothenburg and Copenhagen. Early in May the company proposes to begin operations between Oslo and the following cities: Paris, via Amsterdam and Brussels; Marseilles, via Copenhagen and Zurich; Prague, via Copenhagen; Warsaw, via Copenhagen; and Stockholm. DC-3 and DC-4 aircraft will be used for the services on European and inter-continental lines.

D.N.L., which was originally formed in 1933, is now one of the three partners in Scandinavian Airlines, a joint airline organization formed by Norway, Sweden and Denmark, which will, in due course, operate services from Scandinavia to the United States.

REFUELLING

IN *Flight* of March 28 we gave a telegraphic list of the airfields where civil aircraft fuel could be obtained for coupons. There have since been one or two additions. Broxbourne (Herts) and Weston-super-Mare, for instance, can now supply 73 and 87 octane fuel, while Wolverhampton and Sherburn-in-Elmet (Yorks) have 73 octane fuel available. Cambridge, incidentally, can supply both 73 and 87—and not only the 73 octane mentioned in the paragraph.

CAIRO SPEED-UP

A FAST B.O.A.C. service to Cairo was introduced last week. The new service is operated by twelve-seater Yorks similar to those in use on the South Africa and India schedules, and it is being run twice weekly in each direction, leaving Hurn on Wednesdays and Saturdays, and Cairo on Thursdays and Sundays. The outward journey to Cairo is scheduled to take 12hr 20min, and the homeward journey 13hr 10min. This service brings the total number of B.O.A.C. services to, or through, the Middle East to twenty-four per week in each direction.

I.A.T.A. REGIONAL OFFICES

THE establishment of regional offices for the International Air Transport Association was announced by Sir William Hildred when he arrived at Montreal last week to take up his new post as Director-General of the Association. One of these regional offices has already been opened in Paris and others are planned for New York and Cairo. Sir William said that sixty-one nations now belong to I.A.T.A., which has, in addition to its main committee, eleven sub-committees engaged in the study of a large number of technical problems in order to further the interests of safe, regular and cheap flying. He hoped that, in time, I.A.T.A. would be able to establish co-operative air rates, which will benefit the ordinary people of the world.

PACIFIC STATEMENT

IN an announcement to the House of Representatives on April 10, Mr. Arthur S. Drakeford, the Australian Air Minister, disclosed some of the plans for Pacific air services, and for the set-up of the new corporation, British Commonwealth Pacific Airlines. The statement was, in the main, on parallel lines to that made by Lord Winster after his return from the Pacific Conference.

The B.C.P.A. is to be based on Sydney, and Australia will own fifty per cent of its shares, New Zealand thirty per cent, and Great Britain twenty per cent. The date for the opening of B.C.P.A.'s operations depends on the establishment of the necessary ground organization and meteorological facilities, and also on the conclusion of bilateral agreements with various countries concerned. On the same date as B.C.P.A. begins

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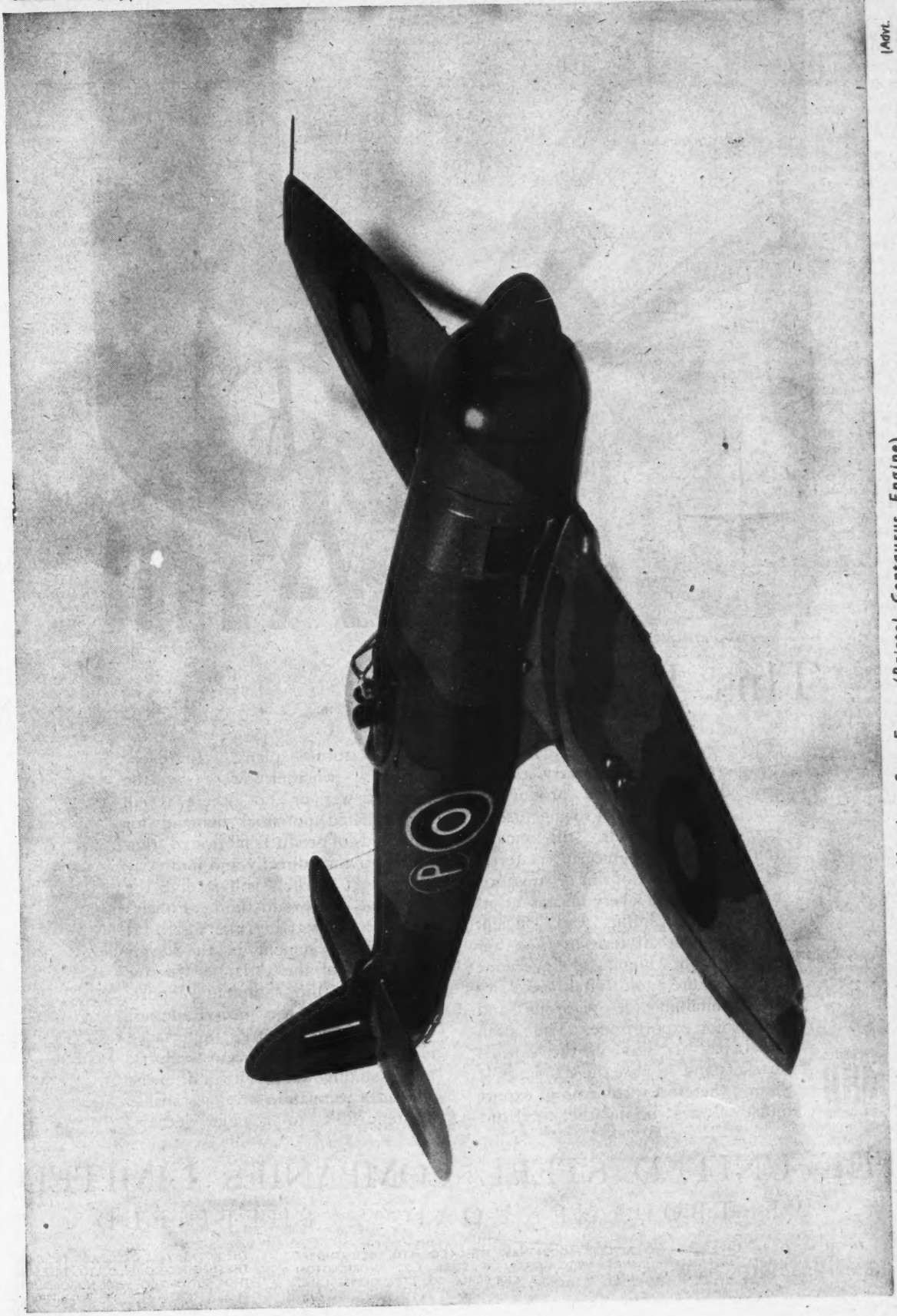
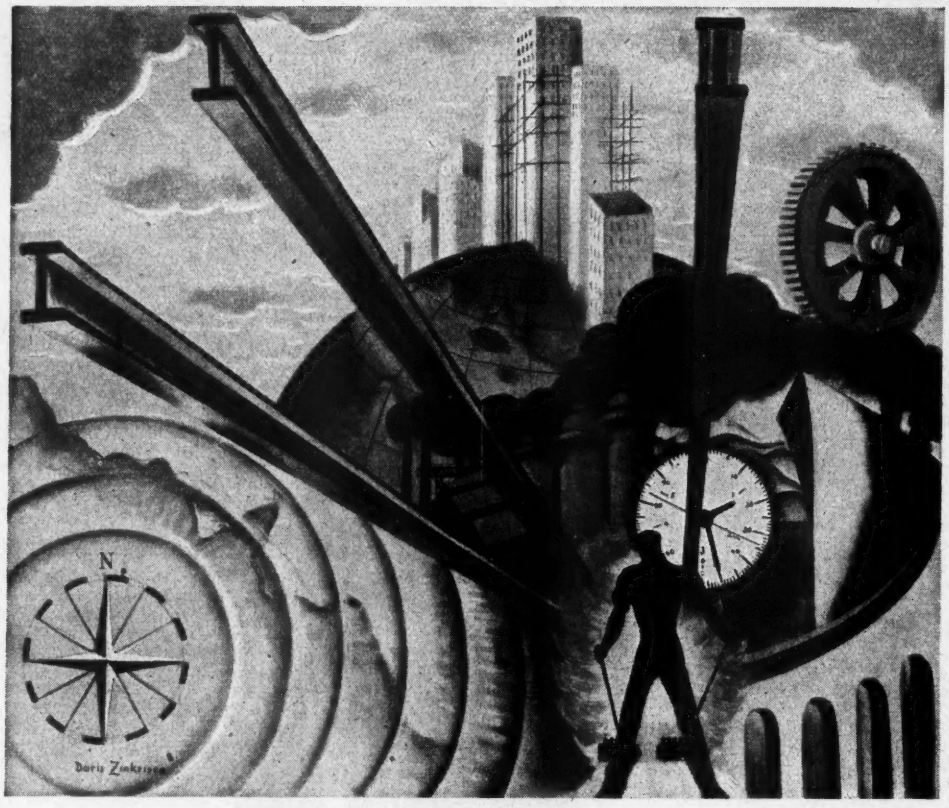


Hawker Sea Fury (Bristol Centaurus Engine).



Painting by Doris Zinkeisen

This Present Age . . 12

The industrial strength and prosperity of any country can be gauged by its steel production. Steel, in spite of the growing use of many new materials, still remains the major basic engineering material. It is the business of this organisation to maintain, by every means at its disposal, continuous and efficient production at all times. The war has brought home to everyone the absolute and vital necessity of maintaining a vigorous and flourishing export trade. The nation must pay its way in the world's markets and so raise the standards of living, therefore problems of export must always be in the forefront of our future plans. In every territory, whether swept by the tide of war or not, there is an accumulated potential demand for hundreds of products fabricated from steel, so that directly and indirectly the export markets will receive the fruits of our production. Policies directed towards international economic agreement in the terms and spirit of the Atlantic Charter will receive our complete support. With all this the magnitude of the task remains, but its importance is so great that the utmost efforts, understanding and goodwill of every citizen of the nation are inescapable pre-requisites to achieve success.

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U.S.P.44

CIVIL AVIATION NEWS

to operate a trans-Pacific airline, similar services will be put into operation by Trans-Canada Airlines and by Pan American Airways. The T.C.A. base will probably be Vancouver, and the company will operate in partnership with B.C.P.A., pooling its traffic revenue on the basis of scheduled operations.

Mr. Drakeford said that Australia and New Zealand had been given authority to operate a regional service in certain defined areas of the South Pacific; also that New Zealand had become the main capital holder in Trans-Tasman Airlines, which is planning a daily service in each direction between Auckland and Sydney.

Speaking of the route to and from the U.K., he said that B.O.A.C. and Qantas Empire Airways would run a parallel partnership of services between Sydney and London, via India. Lancastrians would be used to provide the fast mail service on this route and the slower and more comfortable service would be provided by flying-boats. Decisions on the types of aircraft to be adopted for future operations would be reviewed in September after the results of the Tudor II trials were known.

Mr. Drakeford added that the B.C.P.A. would ultimately use Merlin-engined D.C.-4M aircraft which were now being produced in Montreal under licence from the Douglas Aircraft Corporation, but that, as they were unlikely to be available until next year, it was hoped to arrange an interim service by contract with Australian operators.

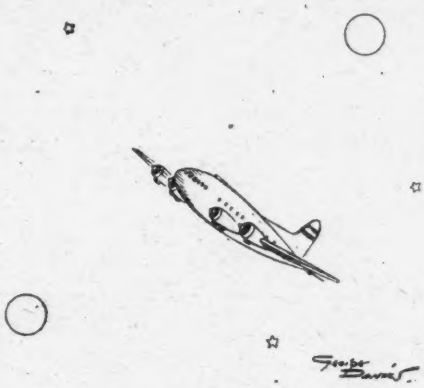
STRAIGHT TRAINING

FIRST of the Straight Corporation's activities to be resumed has been the Central Navigation School. Group Capt. W. N. Cumming, O.B.E., D.F.C., who was in charge of Straight Aviation Training before the war, has taken over its direction, and the curriculum will cover all requirements, from civil conversion courses for ex-pilots to comprehensive *ab initio* training in all branches.

The accommodation taken over at Bush House, London, will allow for six simultaneous classes. In addition to the equipment of its pre-war days, the school will be provided with Link and other "synthetic" trainers and a ciné projector. The Link trainer and other aids will be available also for those who wish for a refresher course. Facilities for practical flying are already being established near London.

Fees for complete courses range from under £20 for the short conversion courses to £55 for a 1st Class Navigator's course. Classes for the "B" Certificate and 2nd Class Navigators started on April 1.

Incidentally, all the directors of Straight Aviation have been engaged on active war service.



"It's all your fault, Flingsby. I told you that you'd get them mixed up."

IMPROVED SUMMER SERVICES

LAST Monday the summer schedules on various internal airlines came into operation. Railway Air Services and West Coast Air Services, for example, stepped up the frequency on many of their routes. The London-Belfast service now runs three times a day instead of once, and there is also an afternoon, as well as a morning, service between London, Liverpool and Belfast. Services between Liverpool and Belfast and Glasgow and Belfast are increased to three daily. All these schedules operate in each direction.

Avros are being used to provide a once-daily service between London and Glasgow (Renfrew), and the flying time for this schedule has been reduced to 2¾ hours. For travellers to and from Eire, West Coast Air Services and Aer Lingus Teoranta are each operating two services in both directions between London and Dublin.

At present, Railway Air Service and West Coast Air Service operations are restricted to week-days, but it is hoped that, during the summer, the delivery of additional aircraft will enable these new schedules to be further improved.

The services between Glasgow and both Belfast and London are run in association with Scottish Airways, Ltd., who, as announced briefly in *Flight* on April 4th, also have improved their services since the beginning of this week. The company has reintroduced the Renfrew-Inverness air link which was suspended at the outbreak of war, so that there are now daily services between Renfrew and Kirkwall in the Orkneys, and Shetland. There is also a new daily service to Shetland from Inverness.

Instead of thrice weekly services, a daily schedule now operates between Inverness and Stornoway, and late-afternoon services have been introduced on the Glasgow-Campbeltown and Glasgow-Islay routes. In addition, Scottish Airways services now link the Outer Hebrides and Renfrew with a daily service in both directions. These services call at Tiree, Benbecula, Barra and Stornoway.

LONDON AIRPORT AGAIN

THE London Airport at Heathrow was the subject of yet another statement by the Minister of Civil Aviation last week. Replying in the House of Lords on April 10 to a question by Viscount Swinton, his predecessor, Lord Winster referred briefly to the history of the selection of Heathrow for use as an airport and outlined once again the plans for its immediate development.

Since the beginning of the year, the various proposals for, and criticisms against, Heathrow have been constantly reported and commented upon in *Flight*, but as Lord Winster's latest statement represents a straightforward summary of the present position, we propose to print a full account of it next week. In the meantime, it is noteworthy that, after Lord Winster had spoken, Viscount Swinton agreed that Heathrow was the best site available and added: "I say without the least hesitation that it was the only possible site on which a great airport for London could be built."

During the course of his statement, the Minister made it clear that the airport at Heston would go out of use as an airfield. He also said later that the future of Bovingdon was at present under discussion, and that the possibility of another site for future development as an additional civil airport for London was being considered.

PROCTOR DELIVERY

TWENTY-SIX Percival Proctor Vs have been ordered for distribution in India. The first of these is being flown out by Mr. Jim Mollison, who recently flew a Proctor V to Brazil on its delivery flight. The aircraft which he is flying to India is finished in turquoise blue with silver wings and has grey leather upholstery. It is for the use of Mr. Rusi Mistri, of Bombay.

CLUB FOR GUILDFORD

THE recently-formed Guildford Aero Club is hoping to begin its activities shortly, but at present it is negotiating for both club premises and the use of an airfield. The club hopes to be elected to the Association of British Aero Clubs and to be included in the allotment of the 100 aircraft made available by the Ministry of Civil Aviation for club flying.

Anyone in the Guildford area who is interested in flying, including fitters and riggers able to assist in the maintenance of the club aircraft, should get into touch with the Honorary Secretary, Mr. J. T. Hills, at 79, Beech Grove, Guildford, Surrey.

BREVITIES

British South American Airways, South African Airways Corporation, Iraqi Airways and the Middle East Airlines Company have all been accepted as active members of I.A.T.A.

* * *

Air mail which was posted in the United Kingdom on March 9 and 20, for civil addresses in Australia, New Zealand and islands in the South-west Pacific, was on board the Lancastrian aircraft which was lost after leaving Ceylon on March 23.

* * *

The Canadian Government has decided to grant a year's extension to the Canadian Pacific Railway in its operation of Canadian Pacific Air Lines. Under Government order the C.P.R. air service was due in May to become a separate unit. Presumably lack of airline facilities generally has caused the postponement of the decree

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

UNWANTED U.S. AIRCRAFT

Why Not Give Them to the A.T.C. ?

YOU published a photograph in *Flight*, April 4th, of an American Marauder being blown up.

Could not the American authorities present some of these unwanted aircraft to the Air Training Corps for instructional purposes? The only chance we have of inspecting aircraft is when we visit an Air Force station. I think it would be an advantage for squadrons to have aircraft for cadets to inspect at will.

AIR CADET.

AMERICAN WISDOM

Was It a Leg-pull ?

I FIND it difficult to repress the urge to aim a rather insidious dig at correspondent Mr. Hansen-Lester (*Flight*, April 4th) in connection with his American literature studies. I am afraid the article in question sounded a little too naïve for even our inexperienced ears, and, like the lady on the radio programme, I feel like coming back with—"but why is he landing down wind Mr. Lester?"

No! Hank, I rather fancy our American cousins are pretty well versed in the rudiments of aviation; they started off on the (W)right track anyway.—Sorry!

R.I.P.

R.A.F., Thornaby.

IN THE AIR

Some Characteristics of the Whitley

THE remarks by "Indicator" on the handling of various aircraft possibly do more to justify the title of the periodical in which they appear than almost any other series.

The fact that the same author deals with the different aircraft on the basis of his own experience gives an idea of how they compare in the hands of one who, we trust, has less reason for prejudice than others.

However, his remarks about the venerable Whitley do call for comment. He states that the last Tiger-engined Whitley went into retirement before 1941. I flew one of these old war horses in June, 1941. This particular Tiger Whitley was, I believe, used for blind approach training.

It has been asserted frequently—not only by "Indicator"—that the Whitley did not do quite as it was told. The fact is that the response to the controls was delayed. Often the response was so leisurely that the pilot had forgotten that an alteration of control had been applied. When the response did become apparent, correction was promptly applied with the same delayed action result.

This bovine behaviour gave endless scope for criticism by instructors, and, for that matter, by anyone who did not happen to be driving. The difficulty in getting the tail down was due to holding off too late and excessive speed. The elevator was only a few inches from the ground, and quite resolute and definite backward movement of the control column was required to overcome ground effect. The latter was probably increased by excessive throttle opening.

With the above consideration in mind and a little practice, the Whitley would do quite a satisfactory engineless glide approach at something under 100 i.a.s., and a three-point arrival could be achieved fairly consistently. The directional stability on the ground was no worse than other types in this era, but I think that the directional difficulties were due to the fact that, as "Indicator" states, the Whitley invariably wheel-landed itself and the pilot woke up some time later, noticed the change of scenery, and closed the throttles abruptly.

When the "Indicator" series is completed it might be interesting to obtain—by interrogation or otherwise—the impressions of a pilot from the other side to describe the aircraft used by Germany. Handling notes and so on must be in our possession and rapidly becoming of purely historical interest, and there is no point in shrouding this sort of thing in a perpetual artificial security fog.

Aircraft behaviour is like finger-prints—similar, but never quite identical. Fear of line-shooting seems to restrict a free exchange of views on this subject, and I consider that "Indicator's" remarks are a real contribution in this direction.

J. NOEL JACKSON, Flt. Lt., Ex-R.A.F.V.R.

FUEL AND WEIGHT

Problem Presented Another Way

IN answer to "Mixture's" problem (*Flight*, March 28th), perhaps if he attempted to show to his flight engineer the problem in another way, greater argumentative success might be forthcoming. I submit this method.

Both engines at 2,200 r.p.m. have the same number of induction strokes per min. Both engines are at the same operating boost pressures.

Assuming both are flying at the same altitude, surely if the volumetric efficiency of both engines is the same, the boost pressure is the same, and the number of induction strokes per min the same, then the consumption per hour must be likewise.

Due to the fact that "B" is the heavier of the two, it will obviously fly at a correspondingly lower air speed, will be in the air longer, and its fuel consumption for the overall flight will be larger.

FRED G. YOUNG.

One Problem Leads to Another

WITH reference to "Mixture" (*Flight*, March 28th) and his problem of petrol consumption on two B-24s cruising at equal power settings, but with different loadings, I am in complete agreement with his theory. An engine consumption per hour figure only goes up when the power output is increased, either by revs or boost, and at a fixed setting, would remain constant despite the loading of the aircraft. Naturally, B's trip time would be longer than that of A, and therefore the total consumption higher; also, in unstable air conditions, B might tend to wallow more than A, which might make it difficult to maintain constant height and speed and necessitate a certain amount of juggling—but otherwise I can find no fault in his reasoning.

This brings to mind a heated controversy which raged in our midst for some days without reaching any satisfactory conclusion. Given two standard-type aircraft, A, loaded to makers' specification, and B, empty, still air conditions and the same approach speed, would the stalling speed of A be appreciably higher than B? I maintain that B would stop more quickly, but that the difference in the stall would not be appreciable. Perhaps someone could sort that out.

P.S.—Wot, no Indicator?

R. L. BENNETT.

Correct Procedure in Range Flying

WITH reference to the letter by "Mixture" (*Flight*, March 28th), and his problem re aircraft "A," all-up weight 52,000 lb, and aircraft "B," a.u.w. 62,000 lb, both using 32in m.p., 2,200 r.p.m.—which will have the lowest a.m.p.g. and highest g.p.h.?

As far as I see, there is no problem, aircraft "B" having the lower a.m.p.g. due to the lower i.a.s. caused by the heavier load, therefore, greater time taken, and the law that it is impossible to create energy or get something for nothing.

With regard to g.p.h. both will be the same, because they have the same power settings. The different weights of the aircraft will not affect the load on the engines, which is kept constant by the propellor c.s.u. (Has the Flight Engineer Leader seen an engine fuel computor for g.p.h. calibrated for different aircraft weights?)

However, this problem is quoted as having arisen from a range flying exercise. For range flying the pilot should certainly not set a comfortable engine condition and then accept any i.a.s. that turned up, regardless of aircraft weights and recommended i.a.s. The pilot is not just flying two or four engines but an aircraft, the characteristics of which must be considered first.

Let us presume aircraft "A" is flying at the recommended i.a.s. for the a.u.w. of 52,000 lb, giving the best angle of attack (maximum lift/drag ratio) and, therefore, best a.m.p.g. for that weight. The pilot of "B," however, quite happy with a set 32in m.p. and 2,200 r.p.m., requires more lift for his extra 10,000 lb weight. He, therefore, pulls back the stick, increasing angle of attack, thus departing from the best angle, causing drag to increase out of proportion to lift obtained and giving himself a further handicap apart from extra weight.

The pilot of "B" should fly at the recommended i.a.s. which will be somewhat faster than for "A" to provide lift for

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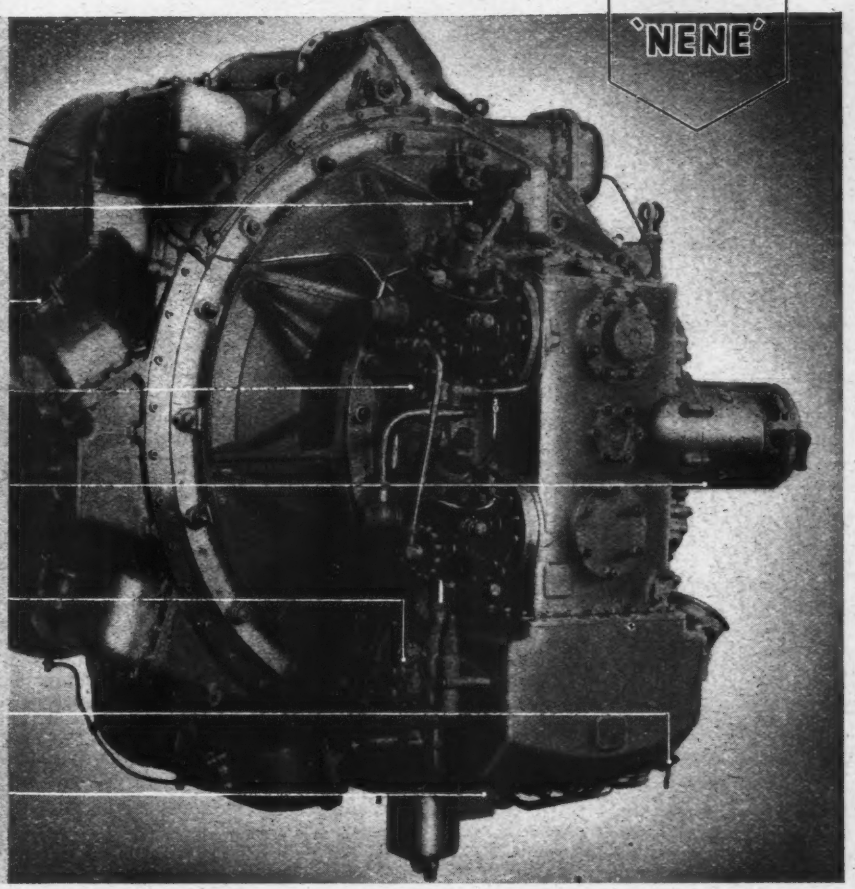

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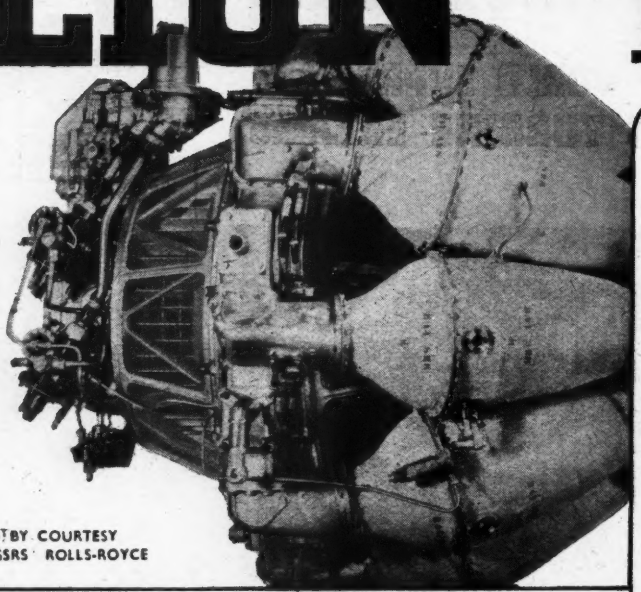

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CORRESPONDENCE

the extra 10,000 lb, maintaining as far as possible angle of attack for maximum lift/drag ratio. The g.p.h. would increase due to the higher revs required, but we are not concerned with g.p.h. as a.m.p.g. is the only indication of good range flying (ignoring winds) which would in this case be more favourable, for less time taken, than "B's" manner of flying as quoted by your correspondent.

DAVID W. HEARSEY.

[In fairness to "Mixture" he did not say that the procedure on which his problem was based was actually employed. As we read it, the case was a hypothetical one to illustrate the point of the argument.—ED.]

BOOSTING BRITISH AVIATION

A New Organization Suggested

I SHOULD be grateful if you would allow me to suggest through the medium of your columns a new scheme for the furtherance of interest in British aviation.

Such a scheme as I suggest would be organized from a central headquarters in London and would be aided by H.M. Government in its early stages if possible. Such a scheme would be known as the British Air League Movement. There would be three branches: the Aeronautical Branch, the Aircraft Recognition Branch and a Public Relations Branch.

Each branch should be headed by an advisory council, as follows:

Aeronautical Advisory Council: Representatives of the Royal Aeronautical Society, Helicopter Society, Helicopter Association, and any other desirable experts.

Aircraft Recognition Branch Advisory Council: An R.A.F. officer, an Army officer, a Naval officer, representatives of the A.T.C. and youth training corps, and any other desirable experts.

Public Relations Council: Editors or representatives of *Flight, Aeronautics, The Aeroplane, A.T.C. Gazette, Sailplane and Glider.* A representative of Associated Press. A representative of the B.B.C.

These councils would each possess a permanent secretary, and membership would be open to all without prejudice of any kind.

Fees (including card and badge): Associates, 4s. 6d. p.a.; members 10s. p.a.; full members £1 p.a. and right to vote.

Such a national organization would have many obvious benefits, and should be officially recognized. Any improvements?

F. G. ISAAC.

[Our correspondent may possibly have overlooked the existence of the Air League of the British Empire.—ED.]

REWARD FOR SERVICE

The Lot of the Ex-Aircraft Apprentice

A GOOD deal has been heard in the Press recently about resettlement, pensions, and the future conditions for the personnel of the armed forces. I crave your space to air the case of the ex-aircraft apprentice who was commissioned during the war.

Your readers will be familiar with their pre-war situation. They were recruited directly from secondary schools by competitive examination, with the promise of an attractive career in the R.A.F. The baton of the Air Chief Marshal was to be hidden in one haversack, and in any case the training to be received was to be such as to fit them for almost anything.

Now the training was good, but somehow the eye of the needle which led to the officers' mess was painfully narrow.

There were cadetships, it is true, but how few; and the qualification was often more a matter of social and athletic suitability than of real merit. In any event, the competition was so fierce that only the really exceptional, who played some sport superbly, stood a chance even of consideration.

When later (after conquering the resentment in the ranks against the breed) the ex-apprentice applied for flying training, the competition was equally severe. Often six or more appearances before A.O.C.s were necessary, and even when the sanctum of the F.T.S. was breached, the slightest false step was sufficient for banishment for ever from the magic circle of those who took the air.

Imagine, then, the disillusion on meeting in the squadron the "short-service" officer, in some cases a few who had failed the entry examination for apprentices some years before, but in all cases with no comparable experience.

Imagine, too, the feelings of the ex-apprentice who mistook a "5" for a "6" on his medical, and later found his technical specialist officer a "G.D. star," thus achieving a permanent or medium appointment.

Still, came the war, and the opportunity for most of promotion beyond their dreams. In general, their competence was proved in the hardest test of all, and they thought that surely their services would be rewarded in the Peace.

But the Peace is here, and the reward? A few, a very very few, may be selected for permanent commissions. Some may be offered the chance of postponing "the beach" for a few years by that incomparable snare and delusion the "extended service commission." The remainder—the great majority—can either choose a return to the Sgts.' Mess, or to cast their lot in "Civvy Street." Air Commodore Harvey has shown in the House the failure of the so-called "Higher Appointments Committee." The average employer shows very rapidly what he thinks of the "ex-regular," and, by way of illustration, points to his office boy who has returned a lieutenant-colonel.

And when our ex-apprentice, desperate by this time, turns to E.V.T., he finds he is barred from participation because he "has made the R.A.F. his career."

What must they think of the recent correspondence in *The Times* anent the scaling-up of officers' pensions, when they consider their own £90 p.a. or so?

Truly, Sir, if asked to send their sons to the service of the King in similar conditions, might they not be forgiven if they remarked that the answer was to be found in "Pygmalion"?

"WING CO.," Rtd.

KEEPING THEM RUNNING

Power Losses in Gas Turbines

AS one who has had practical experience of gas turbine maintenance, I would like to challenge some of Sqn. Ldr. Cracknell's statements made with regard to operational faults and rectifications (*Flight*, March 28th).

For instance, the statement that, in the event of erratic operation "it is customary to change either the throttle valve or A.C.U." needs qualification. Such a rule is bad maintenance practice as units should be changed only after logical elimination. In any case, a lot depends on the nature of the "erratic operation." If, as I understand it, the Squadron Leader means r.p.m. "hunting," then the A.C.U. can rarely give rise to such a fault. The usual cause is a faulty fuel pump. A defective A.C.U. usually passes excessive quantities of fuel back to the tank, if of the barostat type, or else restricts pump delivery if of the B.P.C. type. The symptoms will range from failure to obtain maximum r.p.m. to failure or difficulty to start, according to the type of A.C.U., and the exact nature of the fault. The throttle valve rarely gives rise to "hunting" symptoms. The usual fault with this unit is sticking and failure to answer to pilot's control, especially if the unit is of the cam-operated spring-return type.

There seems little justification for a list of reasons for loss of power, as practically every defect can be placed under this heading. The first-named, low-burner pressure, is really an indication of some other trouble and will produce an effect similar to closing the throttle, i.e., a reduction of r.p.m. and not merely reduction in jet pipe temperature as implied. The same remarks apply to choked burners.

"Aerodynamic breakdown of the turbine nozzle guide vanes" seems rather drastic. Certainly after prolonged running slight distortions do give rise to correspondingly slight power losses, but the term "breakdown" is misleading.

Increase of the compressor casing clearances will have an adverse effect on the engine performance, but such distortion is not readily detectable and, short of complete overhaul, there is little that can be done to overcome it on any particular engine. Distortion of the propelling nozzle is almost unknown and will, if present, be so small as to affect the performance.

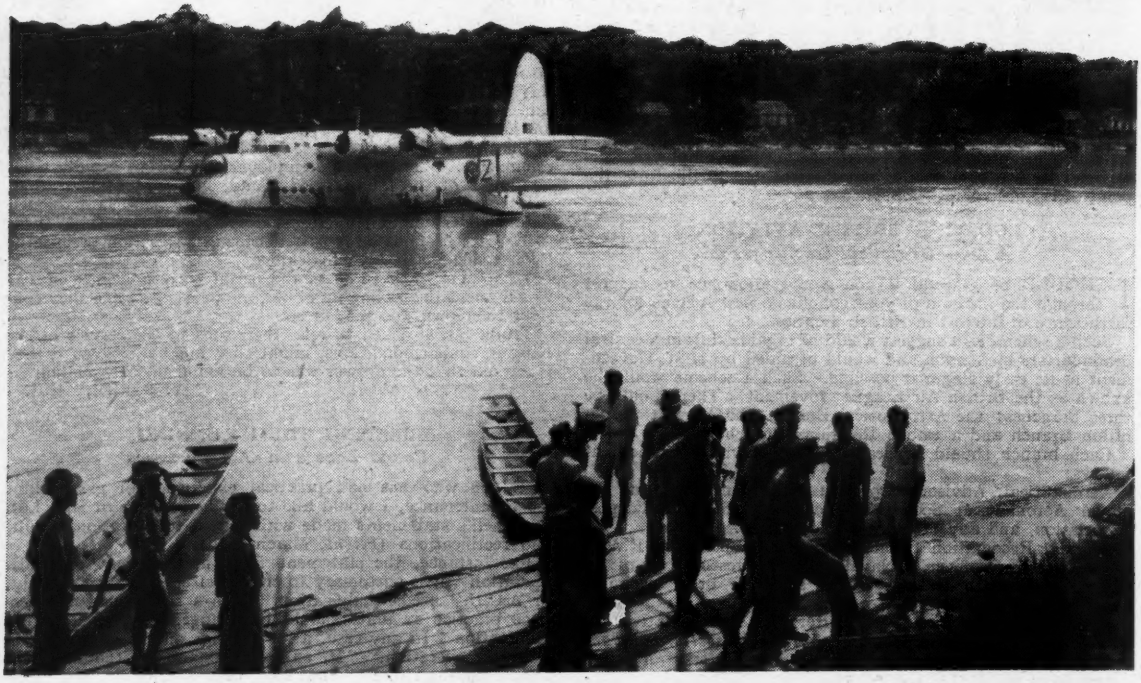
Jet pipe leaks, on the other hand, while not affecting performance may have a deleterious effect on the adjacent airframe or wiring, and are important for this reason.

Partially seized bearings as a cause of performance loss is rather begging the question. While bearing failures are few and far between, such plain bearings as do fail generally give rise to increased rather than decreased clearance, leading to oil seal rubbing, reduced oil pressure and sharp rise in oil temperature, leaks from the bearing sealing glands and, in extreme cases, to turbine or impeller fouling. A failed ball or roller bearing is even rarer, but in any case there is little or no time between the "free" and "seized" states.

With regard to the causes of high jet-pipe temperatures, a fault in the cooling air system will have but little effect on jet pipe temperature. The cooling air merely prevents heat transfer from the turbine disc to the rear bearing.

R. E. T. HACK.

SERVICE AVIATION



STILL IN SERVICE : That magnificent flying boat the Sunderland is still an asset to the R.A.F., for since the end of the war, it has proved to be an extremely useful passenger-carrying aircraft. The picture above was taken in Sarawak, where native boats are being used to bring off the passengers.

Royal Air Force and Naval Air Arm News and Announcements

Ex-apprentices' Party

NEARLY one thousand ex-Halton apprentices attended a reunion party held in London on April 8th, when the principal guest was the Chief of the Air Staff, Marshal of the Royal Air Force Lord Tedder. The Royal Horticultural Hall had been taken for the occasion but, in spite of its size, it appeared to be full to overflowing. It was a purely social evening to afford former "Halton boys" an opportunity to get together again in traditional R.A.F. fashion. In order to ensure that everyone met old colleagues and friends, a series of cards had been spaced around the walls, each one indicating a year in Halton's 25 years of operation, and at each of these points there were gatherings of ex-Halton apprentices in which rank counted for little on this notable occasion. Amongst those ex-apprentices who were present were a number of officers who have now risen to Air rank.

Lord Tedder, in his speech, said that at the time the apprentice scheme was begun it was a hard problem to know quite what the future of the R.A.F. was to be, but, nevertheless, the problem was solved, and Halton-trained men had proved vital to the development of the R.A.F. Now we were faced with a similar kind of problem, but it was no worse, and in many ways better, than in 1920. Lord Tedder added that he had great faith in Halton.

A speech of welcome to the party was made by the present Air Officer Commanding No. 1 School of Technical Training, Air Commodore J. F. Titmas.. Amongst the notable guests were the Air Member for Training, Air Marshal Sir Roderic M. Hill, the Air Officer Commanding-in-Chief, Technical Training Command, Air Marshal Sir Ralph Sorley, and many Directors of Air Ministry Departments.

A description of Halton school and the training carried out there appeared in *Flight* in the issue dated January 31st, 1946.

Bovingdon Airbase

OPERATIONAL control of the American-built airbase at Bovingdon will revert to the R.A.F. on April 15 when the European Air Terminal Service ceases scheduled flights to and from the Continent and goes over to special mission traffic only.

Brigadier-General Lucas V. Beau, Commanding General of European Air Terminal Services, stated also that the bulk of the personnel would be transferred to Bremen.

Bovingdon was built by the Americans to British design and has been under American control for approximately four years. During the fighting years it was an experimental field for the Eighth Air Force; at the same time it was a centre for the "Cloak and Dagger" operations of the Office of Strategic Services.

Bomb Disposal

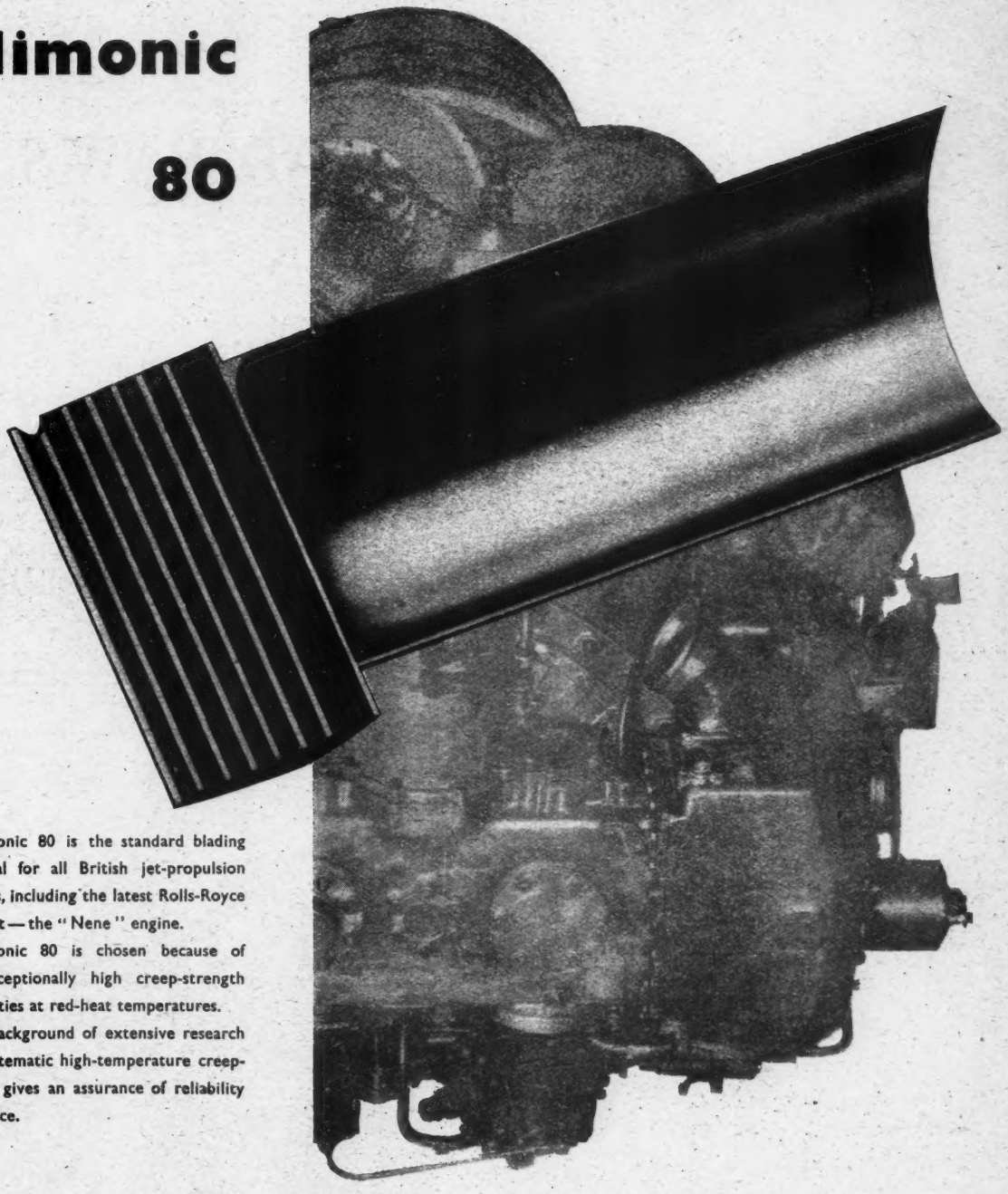
WING CDR. L. HARRISON, G.C., assisted by Sqn. Ldr. T. Clarke and Sqn. Ldr. H. C. Wilson, M.B.E., recently cleared a dump of 700 tons of enemy bombs by employing an entirely new process and equipment which is still on the secret list. The dump was discovered during clearance operations in Steenockerzeel, a suburb of Brussels.

On inspection by Sqn. Ldr. H. C. Wilson it was found that fourteen 500 lb and eight 1,000 lb bombs were each fitted with a type of fuse the object of which was to ensure that any attempt to remove it would cause the bomb to explode and, of course, detonate the remainder of the dump.

Wing Cdr. Harrison and Sqn. Ldr. Clarke went over to Brussels at the end of February and decided to attempt to remove the fuses and booby trap devices. This decision was made because of the proximity of the dump to Brussels and to an historic chateau occupied by the Burgomaster of Perck.

The removal of the bombs to a suitable demolition site was out of the question, as the jolting en route might have caused the mechanism of the fuse to start operating, with disastrous consequences to the lorry and crew. The officers knew throughout that the slightest slip would cause the detonation of the 700 tons of explosives, resulting in much loss of life and damage in the city of Brussels.

Nimonic 80



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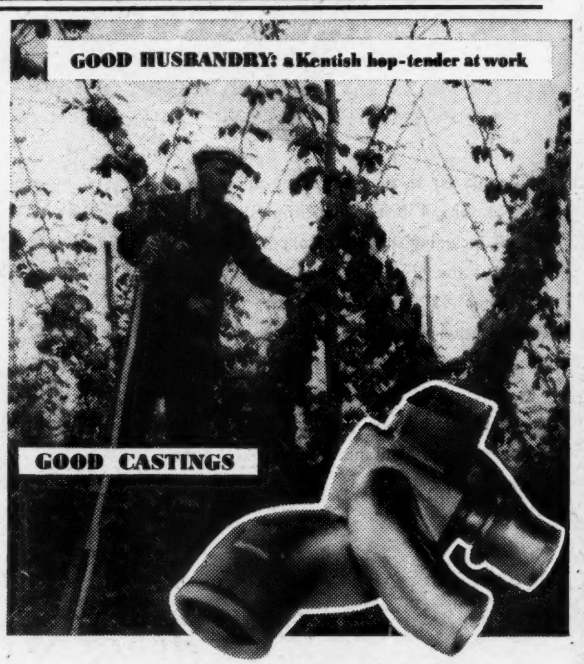

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SERVICE AVIATION

Roll of Honour

Casualty Communique No. 570.

THE Air Ministry regrets to announce the following casualties on various dates: The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 252 are second entries giving later information of casualties published in earlier lists.

Badge of No. 635 Sqn., Royal Air Force — "Nos ducimus ceteri secunter" (We lead, others follow).

Badge of No. 97 Bomber Squadron, Royal Air Force — "Achieve your aim."

Royal Air Force

KILLED IN ACTION.—Sgt. A. Binns; Flt. Sgt. E. M. Clark; Flt. Sgt. P. J. V. Evans; Sgt. C. R. Francis; W/O. J. R. Milne; Flt. Sgt. D. Mouat; Flt. Sgt. H. Scholes; Flt. Lt. J. G. Steel; F/O. J. H. Turton.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. J. F. Shirley; F/O. C. C. Smith, D.F.C.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Act. F/O. D. A. M. Adams; Flt. Sgt. R. L. Alexander; Sgt. D. C. E. Aspinall; Sgt. R. Baptist; Sgt. J. C. J. Bailey; Sgt. H. G. Baker; Flt. Sgt. R. Baxendale; Act. F/O. N. G. Berkeley; Act. F/O. D. W. Best; Act. Flt. Lt. R. W. Beveridge; Sgt. J. Black; Sgt. J. J. Blundell; Act. Flt. Lt. T. S. Brady; Flt. Sgt. F. G. C. Brown; Sgt. W. Butler; Flt. Sgt. T. Charlesworth; Sgt. A. Clayworth; Act. Flt. Sgt. D. Cobb; Sgt. R. Coleman; Sgt. S. H. Cooke; Sgt. G. E. Crumpler; Sgt. J. E. A. Cuthbert; Sgt. A. A. Davey; Flt. Sgt. D. C. Dawson; Flt. Sgt. J. G. Evans; P/O. S. Ewart; Flt. Sgt. J. Farnworth; Flt. Sgt. T. O'C. Fitzgerald; Sgt. L. Foulkes; Flt. Sgt. R. A. Freeman; Flt. Sgt. A. Gleason; Flt. Sgt. C. Glynn; Sgt. B. Griffiths; Sgt. F. H. Habgood; Act. F/O. R. N. Hansell, D.F.C.; Flt. Sgt. L. T. Harman, D.F.M.; Act. Flt. Lt. F. W. Healey; Sgt. D. M. Herbert; W/O. W. Herbert, D.F.M.; Sgt. J. C. Hines; Sgt. K. Jenvey; Sgt. J. E. Jones; Sgt. R. O. Jones; F/O. R. Jones; Sgt. W. M. Jones; Sgt. T. Kilcoyne; Flt. Sgt. W. J. King; Sqn. Ldr. N. A. Kynaston, D.F.C.; Flt. Sgt. A. J. Lewis; Flt. Lt. K. H. Loder; F/O. J. R. McGeorge; Act. Sqn. Ldr. P. D. K. MacGlashan; Sgt. F. C. McIntyre; Flt. Sgt. N. MacPherson; F/O. K. Marlow; Flt. Sgt. J. J. Mather; Sgt. G. A. Maund; Act. Flt. Lt. O. J. Meggeson; F/O. A. N. Mercer; Sgt. E. L. Meredith; Sgt. P. W. L. Moore; Sgt. A. H. Morley; Sgt. P. Morgan; Sgt. D. V. Muir; Act. Flt. Lt. J. Neville; Flt. Sgt. F. E. Palmer; Sgt. V. T. Phillips; Flt. Sgt. R. G. Pocock; Flt. Sgt. H. J. Potter; Sgt. J. A. Prior; Sgt. W. Ray; Sgt. D. Reid; Flt. Sgt. A. Robinson; Sgt. J. W. Robinson; Sgt. T. A. Roby; Sgt. A. Roderick; Flt. Sgt. H. J. A. Rogers; Flt. Sgt. F. Ryder; Sgt. R. H. Sargent; Sgt. J. W. Sharples; Sgt. J. K. Sim; Flt. Lt. A. L. Smith; Sgt. J. D. Smith; Flt. Sgt. M. S. Smith; W/O. L. K. Staines; Sgt. J. Sutcliffe; Flt. Sgt. R. Tams; Flt. Sgt. S. J. Thomas; Flt. Sgt. M. A. Thornhill; F/O. H. A. Thornington; Flt. Lt. E. C. Thyer; Flt. Sgt. D. Vann; Flt. Lt. S. A. Waddington; Sgt. W. E. Wallis; F/O. R. G. Watkins; Sgt. A. Watton; Sgt. J. F. M. Webber; Sgt. W. H. Wells; Flt. Sgt. F. J. Wholey; F/O. E. J. Wicker; Sgt. E. Wilkinson; Flt. Lt. S. E. Wodehouse; Flt. Sgt. D. H. P. Womar; Sgt. R. R. Wood; Flt. Sgt. J. A. Wooldridge; Flt. Sgt. F. O. Worrall; Sgt. D. Young; P/O. W. J. Young.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Act. Wing Cdr. M. A. Brogan, D.F.C.; W/O. A. C. Cheese; W/O. F. E. T. Davy; Flt. Sgt. C. R. Dutton; Flt. Sgt. J. H. Gilbert; F/O. H. M. Goldsmit; Sgt. W. H. M. Greig; P/O. C. Hart; Sgt. C. L. Jones; Sgt. R. L. Leforte; Sgt. J. F. McHugh; F/O. A. G. Martin; Sgt. E. Mitchell; F/O. J. Ritchie; Flt. Lt. D. A. Sheppard.

MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. E. H. Lomas; F/O. J. S. Wayland.

MISSING.—Wing Cdr. A. E. Saunders; F/O. L. F. Soulsby; Flt. Sgt. V. G. Taylor.

KILLED ON ACTIVE SERVICE.—Cpl. G. H. F. Adams; Flt. Sgt. J. A. Allen; Flt. Lt. G. F. Ayton, D.F.C.; F/O. D. A. Cohen; F/O. E. W. Coleman; W/O. H. J. Collins; L.A/C. A. W. Davison; Flt. Lt. D. E. Gihl; Sqn. Ldr. L. Gregory; L.A/C. C. A. Leigh; P/O. T. B. Locke; L.A/C. A. I. MacKenzie; Sgt. J. J. Pattison; Sgt. K. Powell; Sgt. T. W. Ramsay; F/O. L. Roche; Sgt. H. G. Russell; Sgt. C. F. M. Saunders; Act. Sqn. Ldr. R. W. Turkington, D.S.O., D.F.C.; Flt. Sgt. A. H. Watts; Flt. Sgt. J. W. Wigglesworth; F/O. G. L. Willis; W/O. S. G. Witherspoon.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. J. W. Bridgwood; Flt. Sgt. J. O. Cooper; P/O. R. Crompton; Sgt. J. R. Kennedy; Sgt. C. S. G. Poulton; P/O. K. W. Watson; Sgt. H. S. Webster.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED ON ACTIVE SERVICE.—Sgt. P. B. Kellegher.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. B. Clinton.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. L. C. Alsop; Flt. Sgt. E. J. Clooney; W/O. J. M. Cunningham, D.F.C.; W/O. J. P. Hancocks; Sgt. S. S. Hewlett; Flt. Sgt. G. Mitchell; W/O. G. W. Mogg; Sgt. H. S. Rice; Flt. Sgt. W. G. Walker.

DIED ON ACTIVE SERVICE.—L.A/C. H. Ainsworth; L.A/C. A. J. Bailey; L.A/C. P. A. Baines; L.A/C. F. W. Baker; L.A/C. W. A. Bradley; A/C.1 T. K. Calderbank; L.A/C. J. Carter; Sgt. T. W. Clarke; A/C.2 E. J. Cotton; Sgt. H. Culyer; A/C.1 R. E. Davidson; L.A/C. W. Dixon; Cpl. P. Dunion; L.A/C. H. Eames; P/O. G. E. Farlowe; L.A/C. C. Finney; L.A/C. E. R. Flower; L.A/C. R. F. Hall; L.A/C. J. Howe; A/C.1 L. F. Hutchinson; Sgt. T. A. C. Jenkins; Flt. Sgt. J. G. Jones; L.A/C. T. S. Kell; L.A/C. R. Kitchingman; Cpl. W. G. Lucas; L.A/C. T. McNamara; L.A/C. W. G. Mansfield; L.A/C. J. Meredith; A/C.1 J. G. Moore; L.A/C. R. Ogden; L.A/C. R. B. Powell; Sgt. W. A. Ralph; L.A/C. A. C. Roberts; Cpl. H. Roberts; L.A/C. C. J. Sanford; Act. Cpl. P. F. Secar; L.A/C. F. Smith; L.A/C. K. J. Tucker; Cpl. P. C. Wilkins; L.A/C. E. Williams.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. C. J. Dunshea; Flt. Lt. D. W. D. Guest; W/O. H. A. Hales; Act. Flt. Lt. P. J. Hedderwick; W/O. M. J. Mathers; P/O. A. E. Winter.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. R. A. Ashton; W/O. T. L. Awcock; Flt. Sgt. N. E. Barnes; Flt. Sgt. A. B. Barrett; W/O. M. A. Baxter; W/O. H. C. Bell; P/O. D. P. Billman; F/O. K. C. Binnie; Flt. Sgt. H. K. Brown; Flt. Sgt. J. R. Burgess; F/O. J. F. Bush; Flt. Sgt. I. W. Calder; P/O. R. L. Carr; P/O. D. G. Charlick; Flt. Sgt. R. Coates; P/O. R. T. Collins; F/O. A. A. Connor; Flt. Sgt. H. J. Conquest; Flt. Sgt. R. C. Dalton; Flt. Sgt. B. D. Dyer; F/O. J. A. Ewen; F/O. C. R. Fairbairn, D.F.C.; Flt. Sgt. L. Fallon; F/O. A. B. Fitzhardinge; F/O. E. G. Fletcher; F/O. G. Fryer; Flt. Sgt. L. J. Gilbert; P/O. H. Glasby, D.F.C.; Act. Flt. Lt. J. E. Goddard, D.F.C.; P/O. L. J. Grey; F/O. M. F. Hamilton; Act. F/O. R. B. Hardie; Flt. Sgt. W. E. Hathaway; Flt. Sgt. S. J. Hayes; F/O. I. P. Hourigan; Flt. Sgt. R. E. James; Flt. Sgt. A. H. Jenkins; Act. F/O. D. S. Lade; W/O. R. Legay, Brereton; W/O. D. J. Lester; Flt. Sgt. T. R. Lowther; Flt. Sgt. G. W. McLeod; Act. F/O. R. L. Maloney; W/O. J. F. Moore; Act. F/O. W. J. Moran; Flt. Sgt. D. A. Paterson; Flt. Sgt. W. Paul; Act. Flt. Lt. K. Roberts, D.F.C.; Flt. Sgt. F. L. Robertson; P/O. A. G. Rodgers; Flt. Sgt. J. Sheen; Flt. Sgt. W. T. Simpson; W/O. B. S. Smith; Flt. Sgt. J. L. Stagg; Flt. Sgt. M. Stanley; Flt. Sgt. H. Stenhouse; P/O. N. E. Webb; Flt. Sgt. A. L. West; P/O. W. H. E. Wright; P/O. G. York; Act. Flt. Lt. P. E. Young.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. C. McC. Cahill; Act. F/O. R. B. Eggins; Flt. Sgt. P. J. Madden; Flt. Sgt. R. V. Richardson; Flt. Sgt. A. B. Walker; Flt. Sgt. C. J. Watson.

MISSING.—Flt. Sgt. J. E. Wilmith.

KILLED ON ACTIVE SERVICE.—F/O. G. Retallack.

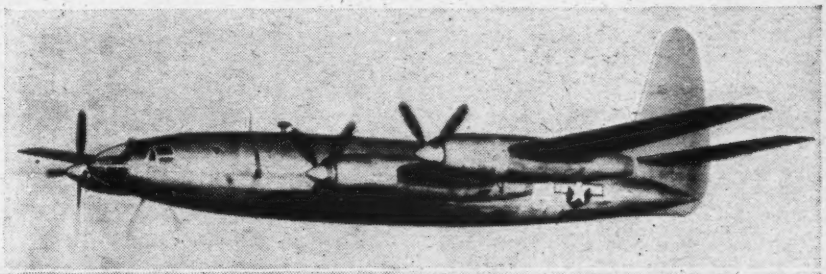
PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. B. L. R. Conolan; Flt. Sgt. E. Evers; Flt. Sgt. J. J. Griffiths; W/O. M. T. Lee; F/O. R. T. Marstella; F/O. F. L. Pepper; W/O. K. H. Watts.

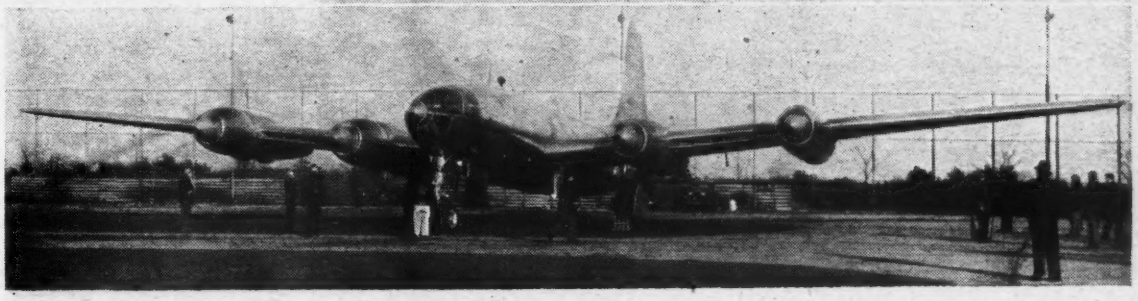
PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—W/O. A. L. Chappell; Flt. Sgt. G. S. Reader.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—W/O. K. S. Hanson.

RAINBOW PRECURSOR: The Republic XF-12, shown here in prototype form, was originally designed for long-range photographic reconnaissance work in the Pacific theatre of operations. It is more interesting today because it is the design on which the Republic Rainbow transport will be based. Presumably this transport will be entirely similar in outline to the XF-12.





SERVICE AVIATION

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. S. E. Bostwick; F/O. R. W. Hodgson; Flt Lt. R. J. Radcliffe.

KILLED ON ACTIVE SERVICE.—Flt. Lt. V. J. Sopuck.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. H. R. Anderson.

DIED ON ACTIVE SERVICE.—Sqn. Ldr. R. E. Coffey, D.F.C.; L.A/C. A. J. G. Mc.C. Elliott.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. J. D. A. Beal.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—W/O. W. G. Abbott; Flt. Sgt. B. W. Bateson; Flt. Sgt. J. M. Biggar; P/O. L. L. Bonisch; W/O. R. J. Braddock; F/O. G. W. Browne; F/O. J. G. Cahir; F/O. G. K. Christensen; Flt. Sgt. J. R. Court; P/O. N. D. Davidson; P/O. R. B. Ede; Flt. Sgt. P. Falkiner; Flt. Sgt. J. P. A. Giles; Flt. Sgt. W. B. Hunniford; Flt. Sgt. F. F. A. Jenkins; Flt. Lt. A. Mewa; Flt. Sgt. B. Milne; P/O. G. V. B. Patterson; P/O. P. M. Price; Flt. Sgt. E. J. Quinn; F/O. A. O. Rodgers; Act. Sqn. Ldr. E. W. Sachtler; Flt. Sgt. A. J. P. Souter; P/O. H. W. Uru; W/O. B. Ward; Act. Wing Cdr. S. D. Watts, D.S.O., D.F.C.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—F/O. A. O. Ellis.

MISSING.—W/O. D. J. Gallagher; Flt. Lt. D. C. Finlayson.

PREVIOUSLY REPORTED PRISONER OF WAR, NOW REPORTED DIED ON ACTIVE SERVICE.—W/O. G. M. Goldfinch.

South African Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Lt. R. G. Jennings.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Lt. J. Burt; Capt. R. V. F. Heiden.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Maj. T. P. L. Murray, D.F.C.

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—2/Lt. K. Hoyer.

KILLED ON ACTIVE SERVICE.—2/Lt. B. C. Bond.

DIED ON ACTIVE SERVICE.—Col. W. Hugo; Lt. Col. P. S. Joubert, D.S.O., A.F.C.

Casualty Communique No. 571

Of the names in this list 226 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Sgt. F. J. Howell.

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. D. H. Henson; Flt. Lt. D. A. Smith.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. T. L. Jones; Act. Sqn. Ldr. W. H. B. Short, D.F.C.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. A. J. Alden; Sgt. B. G. Aldred; Sgt. T. Alldritt; Flt. Sgt. K. Archibald; P/O. G. H. Ardley; Sgt. D. S. Armstrong; P/O. A. W. Atterton; F/O. R. Barker; Flt. Lt. H. Bean; Sgt. H. Bedford; Sgt. J. S. Bennetts; Sgt. J. E. Benton; Sgt. A. R. J. Bosworth; Sgt. H. W. Brotherhood; Sgt. A. J. Chase; Flt. Sgt. E. C. Coldicutt; Sgt. G. D. Cossins; Sgt. D. C. Cullum; Sgt. E. J. Culmer; Sgt. W. N. Curtums; Sgt. S. R. Curtis; Sgt. W. Darby; Sgt. J. Davison; W/O. H. Dixon; Sgt. R. E. Elliman; Flt. Sgt. F. S. Elliott; Flt. Lt. J. J. Emery; F/O. B. R. Emmett; Sgt. J. Fawkes; Sgt. A. A. Flood; Flt. Sgt. R. W. Forrest; Act. F/O. D. C. Freeman, D.F.C.; P/O. W. Galbraith; Sgt. G. V. George; Sgt. E. Gillen; Sgt. A. S. Gordon; Sgt J. B. Hamilton; Sgt. K. J. Hamilton; Flt. Sgt. J. H. C. Heasman; Flt. Sgt. F. E. Hennessy; Sgt. A. Hill; Sgt. F. L. James; Flt. Sgt. J. Jefferies; Flt. Sgt. S. Jenkins; W/O. C. A. Jones, D.F.M.; Sgt. L. J. Jones; Sgt. W. K. Jones; Sgt. N. Joyce; Sgt. T. Kelso; Flt. Sgt. B. S. Kent; Flt. Sgt. A. A. Law; P/O. T. J. A. McFadden; Flt. Sgt. S. G. McLaren; Flt. Sgt. D. J. Maguire; Flt. Sgt. T. M. Meir; Flt. Sgt. J. W. Morris; Sgt. W. C. Muir; F/O. R. H. Munsey; Sgt. R. W. Myers; F/O. J. Negus; F/O. B. K. Nice; Flt. Sgt. F. Ormson; Sgt. W. G. Owen; Flt. Sgt. L. G. Page; Flt. Sgt. W. R. C. Parfitt; Flt. Sgt. F. Phillips; Sgt. P. M. Piper; Flt. Sgt. A. H. J. Plastow; Flt. Sgt. S. J. Poole; Act. Wing Cdr. E. L. Porter, D.F.C.; Sgt. G. Price; Flt. Sgt. M. G. Price; Sgt. R. Poulsom; P/O. B. A. Pullin, D.F.C.; Sgt. L. V. Ratcliffe; Flt. Lt. E. J. C. Richardson; Sgt. F. Ritchie; Flt. Sgt. H. S. Rosher; W/O. L. H. Smith; Flt. Sgt. P. G. Stiefel; Sgt. E. Thompson; Sgt. D. J. J. Timms; Flt. Sgt. E. Tomlinson; Flt. Sgt. S. A. L. Townsend; Flt. Sgt. G. A. Walker; Flt. Sgt. R. E. G. Waltrich; Sgt. D. R. Ward; Sgt. H. Ward; F/O. N. R. Waring; Sgt. G. E. Warren; Flt. Sgt. B. A. Watson; Sgt. A. T. White; Sgt. B. White; P/O. C. A. White; Flt. Sgt. R. J. Wilkinson; Sgt. L. Worley.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. P. K. Ashcroft; Sgt. H. Ashton; F/O. D. H. Atkinson; Sgt. R. W. Baker; Sgt. E. Bone; F/O. E. C. Brown; Sgt. J. B. Clayton; Sgt. W. A. Gamble; F/O. M. Hand; Flt. Sgt. N. Summers; F/O. E. A. Underwood; Flt. Lt. G. B. White

KILLED ON ACTIVE SERVICE.—F/O. S. A. Bennett; P/O. C. R. Branch; P/O. C. R. Chancellor; W/O. D. R. Cook; Sgt. G. P. N. Eyeare; Sgt. R. R. Gibson; Sgt. M. A. Hammond; Sgt. L. R. Hollett; F/O. K. H. L. Houghton, D.F.M.; W/O. T. Jeffery; F/O. F. G. Kent; Flt. Sgt. J. F. Kirk; Sgt. E. S. G. Lambert; Sgt. D. G. Longhurst; P/O. A. Maycock; Flt. Sgt. R. Meanley; Sgt. R. R. Milligan; A/C.2 D. MacM. Mitchell; F/O. N. S. Phillips; Sgt. T. P. Pipe; Sgt. W. F. Reeks; Sgt. E. F. Rogers; Flt. Sgt. A. B. Southwick; Flt. Lt. J. A. Sprigge, D.F.M.; Flt. Sgt. J. E. Wilkinson.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. F. A. Baker; Sgt. K. Chapman; Sgt. A. R. D. Donaldson; F/O. W. McL. Earl; P/O. I. Hardman; Sgt. D. W. Hope; F/O. W. J. Hynds; W/O. J. I. Munday; Sgt. J. L. Murray; L.A/C. J. L. Whitehouse.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—F/O. W. S. Cameron; F/O. H. D. Dinmore; Sgt. J. Dubois; Sgt. R. W. Holmes; Sgt. H. P. McCafferty; Sgt. P. Share; Sgt. G. H. Thirkettle; F/O. R. Warwick; Flt. Sgt. L. C. Welham; Sgt. G. A. Wilson; Sgt. T. Wilson.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. G. Whitaker.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Lt. E. R. Carruthers; Flt. Lt. T. V. Laffey.

DIED ON ACTIVE SERVICE.—L.A/C. E. Armstrong; A/C.1 A. Bertie; F/O. R. S. Calder; Act. Cpl. W. E. Caunt; Cpl. H. Chadwick; L.A/C. T. H. Davies; L.A/C. F. Ferguson; A/C.2 R. Fordham; L.A/C. A. Geary; L.A/C. G. Graham; Sgt. M. Kershaw; Cpl. D. Lee; Sgt. C. M. O'Donnell; Sgt. C. G. Osmond; L.A/C. R. Preston; Cpl. T. S. Quayle; L.A/C. H. R. Salisbury; L.A/C. C. G. Smith; Flt. Lt. C. W. Smith; Cpl. R. C. Smith; L.A/C. S. P. Smith; Cpl. G. Thomson; Cpl. O. B. Ward; L.A/C. H. A. Williams; W/O. P. C. Wright; L.A/C. V. A. Wright.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.2 P. M. Blackwell; L.A/CW. I. Maggs; L.A/CW. A. E. Weeks.

Royal Australian Air Force

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. R. E. Bull; F/O. H. J. Gibbs; F/O. G. W. Hassell; Flt. Sgt. A. C. Innes; F/O. E. J. Loonam; F/O. E. R. Loton; Flt. Lt. K. A. V. Moore; W/O. H. I. Pinkerton.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Act. F/O. J. E. Corlis; F/O. D. E. Higgs; Flt. Sgt. J. P. Ion; F/O. W. A. MacLennan; Flt. Sgt. L. H. Mason; F/O. K. Pond; Flt. Sgt. K. Richardson; W/O. L. A. Smith; W/O. W. D. Webster; Flt. Sgt. J. G. Williams; P/O. J. M. C. Wilson.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Act. F/O. D. I. McDonald.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—F/O. A. G. Rolston; Flt. Sgt. J. W. Sharp; F/O. B. P. Smith; Flt. Sgt. C. W. F. Wedd.

Royal Canadian Air Force

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PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—P/O. R. C. Carnegie; F/O. A. W. Heughan; F/O. H. L. Shepherd; W/O. R. V. Weston.

KILLED ON ACTIVE SERVICE.—W/O. J. Brown.

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DIED ON ACTIVE SERVICE.—F/O. G. McCracken; L.A/C. R. E. Petley.

Royal New Zealand Air Force

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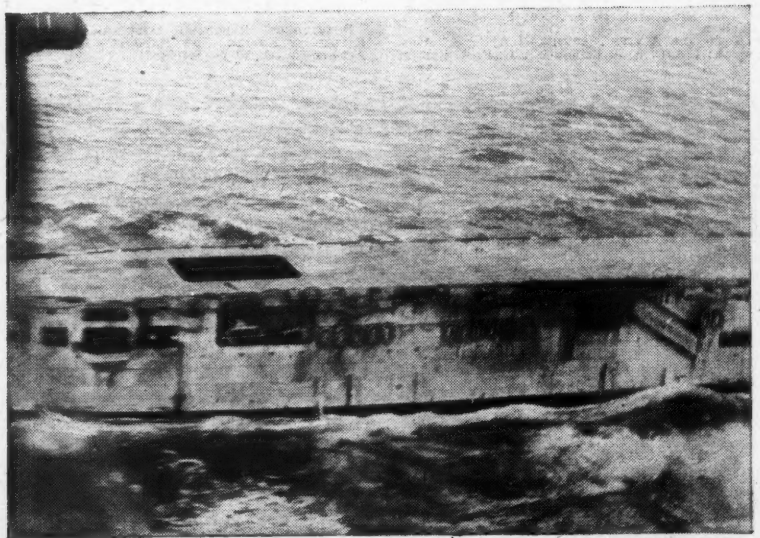

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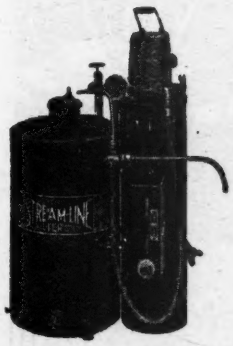

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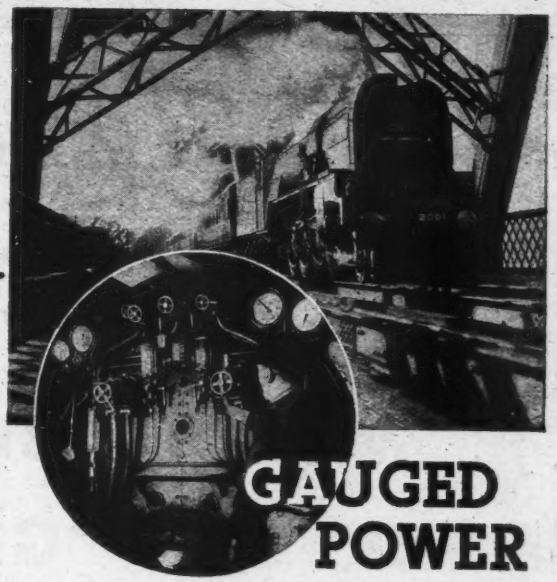

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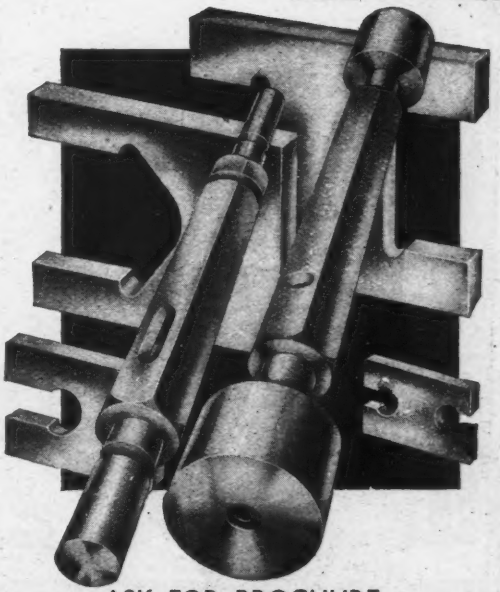

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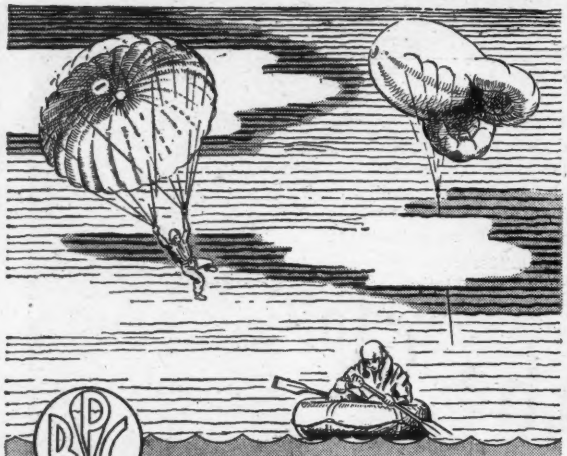

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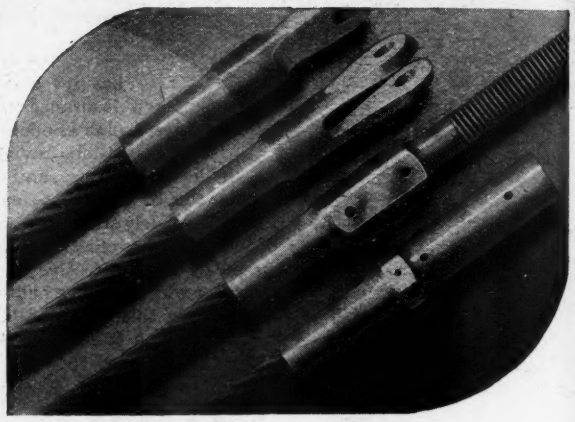

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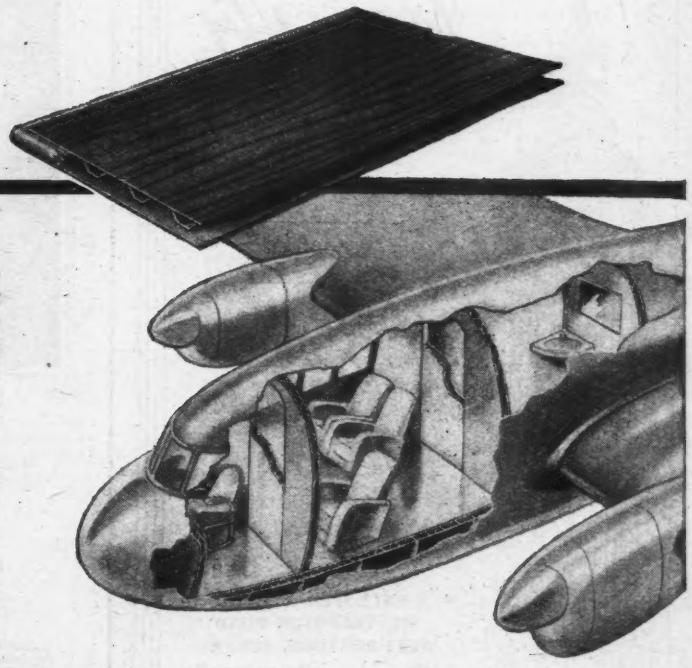

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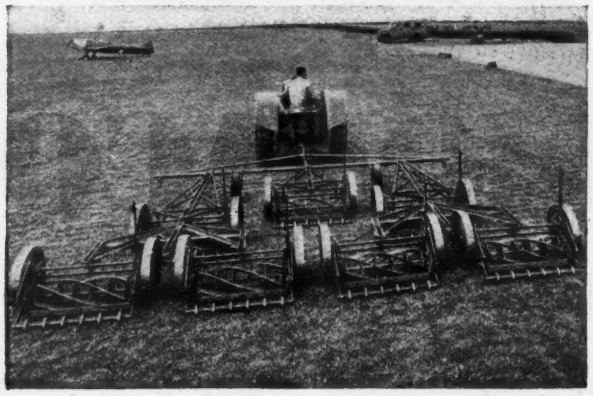

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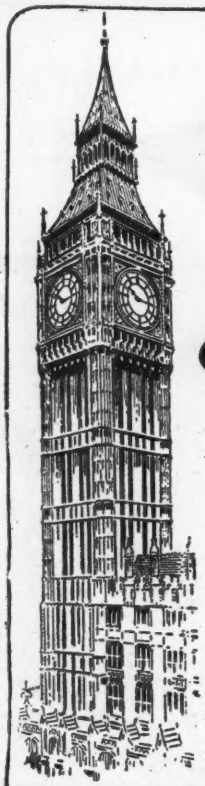

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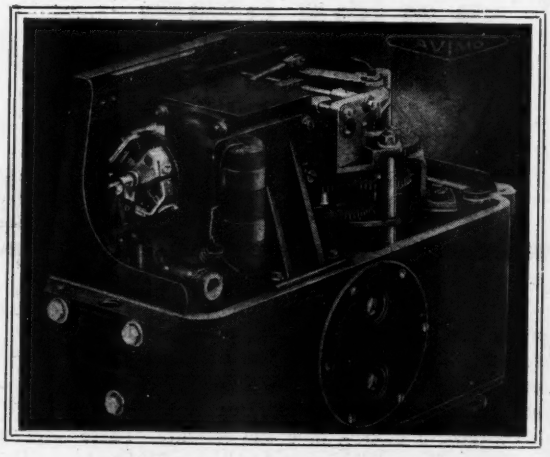

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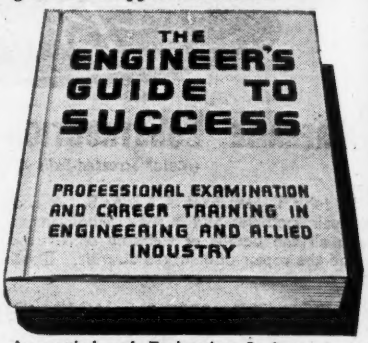

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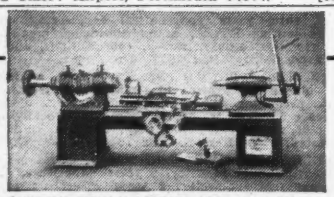

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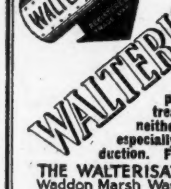

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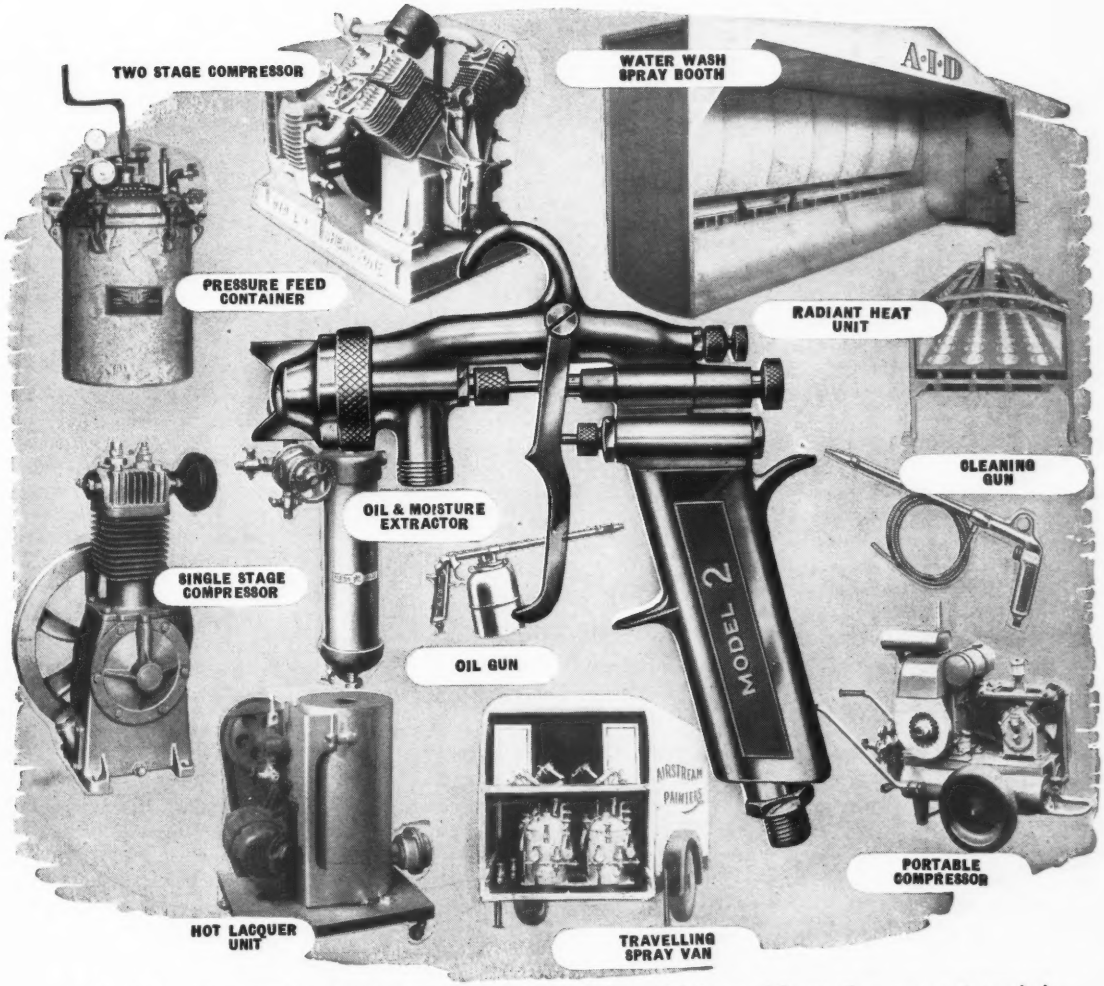

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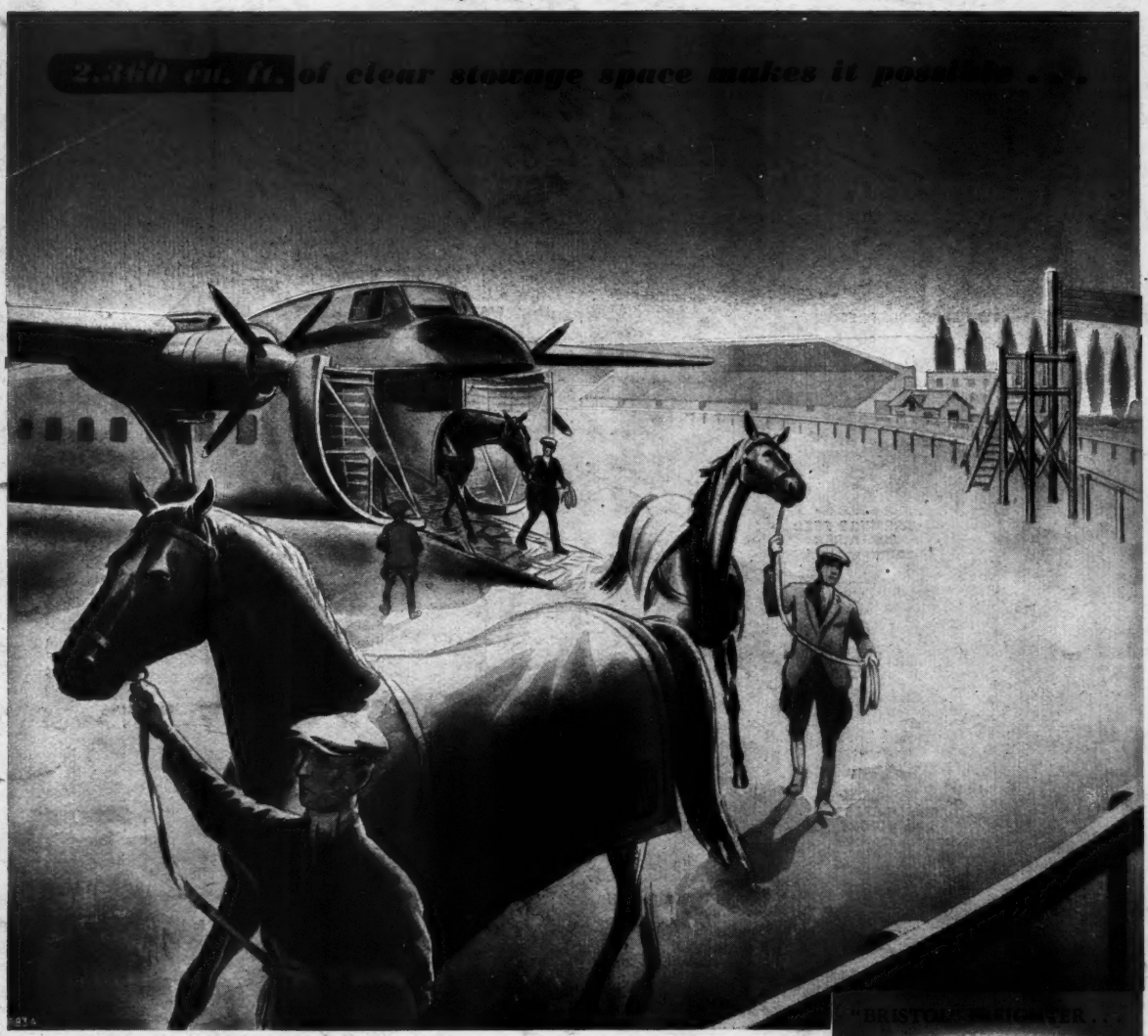

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